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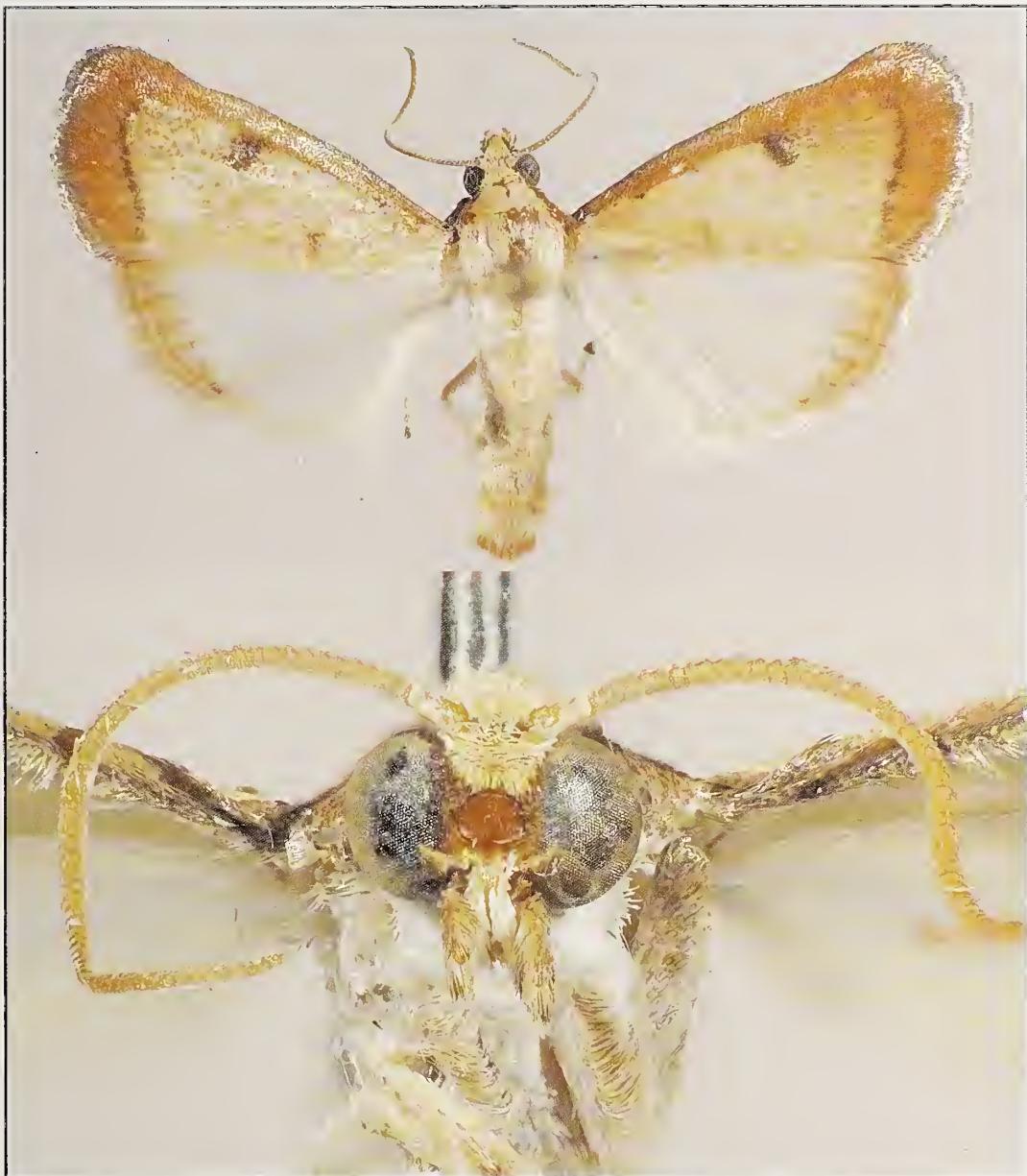
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Cover Illustration: Above: dorsal habitus of holotype of *Suinoorda maccabei* n. sp. Below: head of paratype of the same, collected 15 April 1986 by T.L. McCabe, in the CUIC, showing the greatly expanded frontoclypeus. Images by James Hayden. See journal article on page 185.



A NEW GENUS OF CARIBBEAN ODONTIINAE WITH PALAEOTROPICAL AFFINITIES
(LEPIDOPTERA: CRAMBIDAE)

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ABSTRACT. *Suinoorda maccabei gen. et sp. nov.* is described from the Bahama Islands and Cuba. Cladistic analysis of the Eurrhypini (39 terminals, 48 characters) tests the phylogenetic relationships of the species and confirms that it is the earliest-diverging member of an otherwise Palaeotropical clade characterized by a modified plectrum of the eurrhypine genitalic stridulatory apparatus. The new species is not closely related to other Neotropical Eurrhypini with similar but plesiomorphic or convergent maculation. The nomenclatural status of other Eurrhypini is revised. *Clupeosoma orientale* (Viete) **comb. nov.** and *Clupeosoma vohilavale* (Marion & Viette) **comb. nov.** are transferred from *Autocharis* Swinhoe, *Noordodes magnificalis* (Rothschild), **comb. nov.** is transferred from *Noorda* Walker, and *Hyalinarcha hyalinalis* (Hampson), **comb. nov.** is transferred from *Boeotarcha* Meyrick. *Metrea* Grote is synonymized with *Cliniodes* Guenée, **syn. nov.**, and the synonymy of *Basonga* Möschler with *Cliniodes* is reinstated. Missing data for female genitalia and larval feeding habit are predicted with a simple method.

Additional key words: Stridulation, seed feeding, frontal structure, diagnosis, missing data

INTRODUCTION

The purpose of this paper is to describe and diagnose a new, phylogenetically unique species of snout moth from the West Indies. In the course of my studies on the Neotropical Eurrhypini Leraut & Luquet (Crambidae: Odontiinae), T.L. McCabe brought to my attention a series of specimens that he collected in 1986 on Great Exuma, Bahama Islands. I subsequently found in the Museum für Tierkunde (Dresden) one specimen collected in 2000 by J.-P. Rudloff in eastern Cuba. The male specimens significantly resemble other tropical Eurrhypini in having almost entirely white forewings with the antemedial line nearly absent, a black discocellar spot, and a simple, narrow, reddish terminal band (Fig. 1). This pattern occurs in Neotropical eurrhypines such as *Argyrarcha* Munroe, *Sobanga* Munroe, and *Cliniodes paradisalis* (Möschler) (Fig. 4), as well as in Palaeotropical genera such as *Autocharis* Swinhoe and *Pseudonoorda* Munroe (Fig. 3).

Dissection of males confirmed its placement in the Eurrhypini and more precisely with a group of genera that share an unusual, hitherto unrecognized modification of the genitalic structures that characterize the tribe (Figs. 8, 9) (Leraut & Luquet 1983). Its closest relatives are restricted to the Palaeotropics, ranging from Africa to New Guinea; some of these genera share the wing pattern (e.g. *Pseudonoorda*), and others do not (*Clupeosoma* Snellen). However, the new species also shares symplesiomorphies with members outside the group. Most strikingly, the frontoclypeal suture, just above the base of the haustellum, is exaggerated in a porcine snout of nearly circular shape (Fig. 5). This appears to be homologous to the distinctly upturned

frontoclypeus of *Autocharis* and *Dicepolia* Snellen (Fig. 6). The new species also has plesiomorphic forewing venation and genitalic androconia. A new genus seemed necessary, but hesitating to add another name to an already nomenclaturally atomized subfamily, I tested its relationships by cladistic analysis.

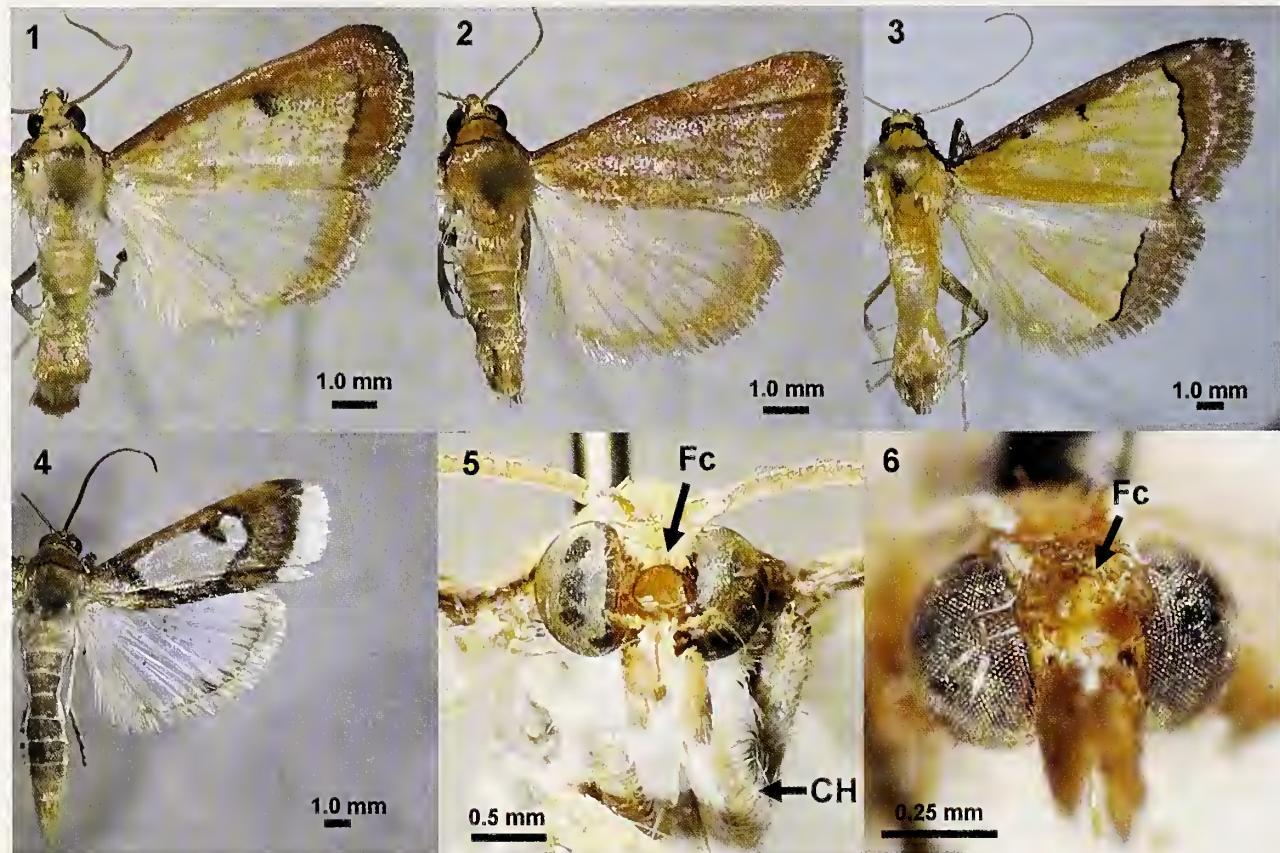
The genitalic structures relate to the diagnosis of the Eurrhypini. The tribe includes nearly two hundred species in about four dozen genera, with greatest diversity in Palaeotropical forests. The tribe has been characterized by three apomorphies of the male genitalia: (1) a pair of "lamelliform structures" on the 8th abdominal sternite (Leraut & Luquet 1983), (2) a pair of large, square to oblong "squamiform structures" attached to the vinculum (Minet 1980; Figs. 8, 9: Sq), and (3) a plume of long scales in medial position on the vinculum (Nuss & Kallies 2001). The second and third structures have been confused in previous studies (see Discussion), but in this paper, I identify the squamiform structures with the two square membranes. The lamelliform structures are bundles of a few robust chaetiform setae cemented together and directed posteriad. The chaetae apparently rub against the numerous transverse ridges of the squamiform structures. The structures been observed to have a stridulatory function for male courtship in one species, *Syntonarcha iriastis* Meyrick of Australia and Wallacea (Gwynne & Edwards 1986), but none of the many other species with the apparatus have yet been studied. The squamiform and lamelliform structures in *S. iriastis* are strongly modified, so the species was omitted from this analysis.

In the new species and its Palaeotropical relatives, the lamelliform structures are absent from the eighth

sternite (S8) and appear to be functionally replaced by a pair of lozenge- or ribbon-like fields on the intersegmental membrane between S8 and the vinculum, just anterior of the squamiform structures (Fig. 8: Sep). These sclerotized fields bear transverse ridges so that the outline and texture are reminiscent of cuttlebones. Reflecting the terminology of Minet (1980) and Leraut & Luquet (1983), I refer to these as *structurae sepiformes* (Gk. *sepion*, cuttlebone).

The Odontiinae has not been subject to previous phylogenetic analysis, except as a terminal taxon (Solis & Maes 2002). The results demonstrate that the new species is not closely related to several other Neotropical odontiines, despite shared wing patterns and head structures. In addition, explicit predictions are derived from the phylogeny about unobserved characters, including unknown feeding habits. Generic transfers are made where evidence is sufficient, but broad nomenclatural changes are not made pending a larger sample of species and characters (Hayden in prep.).

FIGS. 1–6. Dorsal habitus of wings and frontoclypeus. 1, *Suinoorda maccabei* holotype ♂, right half. 2, *S. maccabei* paratype ♀, left half (reflected) (McCabe Coll.). 3, *Pseudonoorda distigmatis* ♀ (Congo, Likouala Region: CMNH). 4, *Cliniodes paradisalis* (Jamaica, Moneague: AMNH). 5, *S. maccabei* ♂, frontal aspect of head. 6, *Dicepolia rufipectalis*, frontal aspect of head (USNM). **Fc**, frontoclypeus; **CH**, prothoracic coxal hairs.



MATERIALS AND METHODS

Taxa. The thirty-nine species selected for phylogenetic analysis include Eurrhypini that share similar wing pattern and/or sepiform structures. All known Neotropical Eurrhypini that resemble the new species in maculation are included. The type species of genera were included wherever possible. Two Odontiini serve as outgroups: *Cynaeda dentalis* (Denis & Schiffermüller, 1775), the type species and genus of the Odontiini, and *Tegostoma comparale* (Hübner, 1796). The ingroup taxa are listed in Table 1 with information about slide preparations. For the external characters of many species, additional specimens were examined from the same collections. Species used in this analysis were identified by comparison with original descriptions, digital photographs of type material, and revisions and faunal treatments.

The Neotropical eurrhypine genera were transferred in Munroe (1995). Leraut & Luquet (1983: 528) indicated that *Hyalinarcha* Munroe, *Metrea* Grote,

Pseudonoorda, and *Viettessa* Minet belong in the Eurrhypini based on possession of the apomorphic structures. The following Old-World genera used in this study are hereby placed in the Eurrhypini because their type species possess the structures: *Aeglotis* Amsel, *Autocharis*, *Clueosoma*, *Deanolis* Snellen, *Ephelis* Lederer, *Hemiscopis* Warren, *Heortia* Lederer, *Hydrorybina* Hampson, *Noordodes* Hampson, and *Pitama* Moore. The following misplaced species are transferred to the Eurrhypini for the same reason: *Epipagis ocellata* (Hampson 1916) and *Mecyna catalalis* Viette 1953.

The terminal “*Pseudonoorda brunneiflava*” is a composite of two species: the female is identified as *Pseudonoorda brunneiflava* Munroe, and the male is a closely related undescribed species. The new species has the forewing postmedial line closer to the distal wing edge and the terminal area yellow like the median area, rather than violet. Consequently, the wing pattern (char. 4) is coded as both states because *P. brunneiflava* and *P. metalloma* have a violet terminal area.

The following sources provided specimens used in this analysis: American Museum of Natural History, New York (AMNH); Academy of Natural Sciences, Philadelphia (ANSP); Carnegie Museum of Natural History, Pittsburgh (CMNH); Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa (CNC); Cornell University Insect Collection, Ithaca (CUIC); Instituto Nacional de Biodiversidad, Costa Rica (INBio); Muséum d'Histoire Naturelle, Genève (MHNG); Museo del Instituto de Zoología Agrícola, Maracay (MIZA); Muséum National d'Histoire Naturelle, Paris (MNHN); The Natural History Museum, London (NHM); New York State Museum, Albany (NYSM); Musée Royal de l'Afrique Centrale, Tervuren (RMCA); Naturalis, Leiden (RMNH); Senckenberg Naturhistorische Sammlungen Dresden (Museum für Tierkunde: MTD); United States National Museum, Washington, D.C. (USNM); Museum für Naturkunde, Humboldt Universität, Berlin (ZMHB); Staatliche Naturwissenschaftliche Sammlung Bayerns, München (ZSM).

Preparation. Specimens were examined under tungsten-filament light with a Wild Heerbrugg stereomicroscope. Measurements were taken with an ocular micrometer at 1000X, and coloration was inspected under incandescent light and compared with the *Methuen Handbook of Colour*, 2nd ed. (Kornerup & Wanscher 1967). Photomicrographs were taken with a digital Nikon DX1 camera and Microptics photomicrographer.

Specimens were dissected according to Robinson (1976). Abdomens were macerated for 20 mins. in 10%

aqueous KOH solution in a simmering water bath and dissected in water. After inspection of deciduous hairs and scales, genitalia were cleaned with size 3/0 sable hair brushes and a snipe pinfeather, stained with Chlorazol black E, dehydrated 24hr in 95% ethanol, and mounted in Euparal. Some dissections were stored in glycerin for several months during the process of character coding to observe 3-dimensional structures. Wings were prepared by wetting in 95% ethanol, immersion in acetone for 30s., and denudation of scales in water. Wings were soaked in weak bleach solution (20%) for 60s., brushed again, stained in Eosin-Y (1g / 70% ethanol) for ca. 1 hour, and dehydrated and mounted as for the genitalia above.

Additional slides by E.G. Munroe and preparators in the CNC were examined (Table 1). These were often less informative, as the androconia, scales, and even the squamiform structures were often removed.

Characters. Forty-eight characters were coded in the context of a larger survey of Odontiinae (Appendix A). Characters for phylogenetic analysis were drawn from the external morphology of the head (4), wings (11), tympanal organs (1), male genitalia (22), female genitalia (9), and larval feeding habit (1). Terminology follows Klots (1956), Kristensen (2004), and the LepGlossary (Leptree Team 2008), and terms for tympanic organs follow Maes (1995). Sources of hostplant information are listed in Table 2. The states were delimited with consideration of plausible physiological and behavioral constraints while maximizing grouping information for the taxon sample. Characters are numbered from 0; see Appendix B for descriptions of character states. In the Results and Discussion, parenthesized numbers refer to “(character:state).” Some characters were coded as inapplicable if they depend on the presence or absence of another character. Unobserved characters include antennal ciliation for *Dicepolia munroalis* (Viete) (char. 0), the vincular androconia for *Autocharis barbieri* (Legrand), *D. munroalis* and *Sobanga rutilalis* (Walker) (char. 30), female genitalia for *Aeglotis argentalis* (Christoph) and *Clueosoma atristriatum* Hampson (chars. 37–45), and feeding habit for most terminals (char. 46). Characters were coded for more than one state where a structure either did not clearly belong to one state or where the terminal was polymorphic (exhibiting more than one discrete state among specimens).

Phylogenetic analysis. The data matrix was entered with WinClada v. 1.00.08 (Nixon 2002) (Appendix B). Electronic files are available from the author. The matrix was analyzed with parsimony with TNT v. 1.1 for Windows (Goloboff *et al.* 2003, 2008) on

TABLE 1. Species and specimen preparations included in the analysis. Slide numbers refer to preparations by the author (JEH) unless indicated by preparator's initials.

TAXON	SEX	LOCALITY	SLIDE NO.	COLLECTION
<i>Aeglotis argentalis</i> (Christoph 1887)	1m	Pakistan: Kohistan	270	MTD
<i>Argyraarcha margarita</i> (Warren 1892)	2m, 1f	Brasil: Rio Gr. do Sul	126, 127, 427	CUIC
	1f	Br: Sta. Catharina	2760 M. d'A.	CNC
<i>Autocharis albiplaga</i> (Hampson 1913)	1m, 1f	South Africa: Cape Prov.	93, 119	USNM
<i>Autocharis barbieri</i> (Legrand 1965)	1m, 1f	Seychelle Is.	94, 120	USNM
<i>Autocharis fessalis</i> (Swinhoe 1887)	1m, 1f	India: Orissa	49, 50	USNM
<i>Autocharis mimetica</i> (Lower 1903)	1m, 1f	Australia: NT	189, 190	NYSM
<i>Cliniodes costimacula</i> (Hampson 1913)	1m	Venezuela: Aragua: Rancho Grande	48	USNM
	1f	Costa Rica: Prov. Limón	210	INBio
<i>Cliniodes opalalis</i> Guenée 1854	1m	Peru: Pasco Dept.	59	CUIC
	1m	Peru: Huanuco	61	AMNH
	1m	Venezuela: Tachira	64	MIZA
	1m	Peru: Divisoria	66	USNM
	1m	Bolivia: Cochabamba	162	CNC
	1m	Costa Rica: Puntarenas: Monte Verde	195	AMNH
	1f	Costa Rica: Puntarenas: Monte Verde	172	CUIC
	1f	Jamaica	1107 M. d'A.	CNC
<i>Cliniodes ostreonalis</i> (Grote 1882)	1m, 1f	Canada: Que.: Norway Bay	137, 138	CNC
	1m	Canada: Ont.: Merivale	1319 EGM	CNC
	1f	Canada: Ont.: Merivale	2911 M. d'A.	CNC
<i>Cliniodes paradisalis</i> (Möschler 1886)	1m	Jamaica: Port Antonio	17	AMNH
	1m	Jamaica: St. Andrew Parish	269	ANSP
	1m	Jamaica	2553 EGM	CNC
	1f	Jamaica: Trelawny	154	CNC
<i>Clupeosoma atristriatum</i> Hampson 1917	2m	PNG: New Britain: near Keravat	121, 122	CNC
<i>Clupeosoma sericiale</i> (Hampson 1896)	1m, 1f	Philippine Is: Luzon	53, 54	USNM
<i>Clupeosoma orientale</i> (Viguerie 1954 [1953])	1m	Madagascar Est	258	MNHN
	1f	Madagascar Est	259	RMCA
<i>Clupeosoma volulavale</i> (Marion & Viette 1956)	1m, 1f	Madagascar: Maroantsetra	256, 257	MNHN
<i>Cynaeda dentalis</i> (Denis & Schiffer- de- nominis 1858)	1m, 1f	Germany: Rheingau: Loreley	38, 39	USNM
<i>Deanolis sublimbalis</i> Snellen 1899	1m	Malaysia: Sabah: Kinabalu NP	130	USNM
	1f	Philippine Is: Samar	254	ZMHB
<i>Dicepolia munroealis</i> (Viguerie 1960)	1m	Madagascar: Lakato route	Holotype, prep. unkn.	MNHN
	1f	Madagascar: Anosibe	288	MHNG
<i>Dicepolia roseobrunnea</i> (Warren 1889)	1m	Rio Iça	175	CUIC
	1m	Fr. Guiana: St. Jean de Maroni	BM 22137	NHM
	1m	Brasil: Upper Amazon, Codajás	BM 22138	NHM
	1m	Brasil: Estado Parába	111,915 Heinrich	USNM
	1f	Brasil: Estado Parába	224	USNM
<i>Dicepolia rufitinctalis</i> (Hampson 1899)	1m	Guyana	79	CUIC
	1m	Venezuela: Amazonas	81	MIZA
	1f	Bolivia: Cochabamba	167	CNC
	1m, 1f	Mexico: Ver.: Jalapa	232, 233	USNM
	1m, 1f	Peru: Aispas	234, 235	CNC
	1m, 1f	Panama: Canal Zone	236, 237	USNM
	1m	Bolivia: Cochabamba	238	USNM
	1f	Brasil: Distr. Fed.	239	USNM
	1m	Brasil: Rondonia	246	LACM
<i>Ephelis cruentalis</i> (Geyer 1832)	1m	Hamfelt Coll.	44	USNM

TABLE I. (continued)

TAXON	SEX	LOCALITY	SLIDE NO.	COLLECTION
<i>Ephelis cruentalis</i> (Geyer 1832)	1m	Hamfelt Coll.	44	USNM
	1m	[unknown]	330	CMNH
	1f	Italy: Basilicata: Monticchio	45	USNM
	1f	Turkey: Dorah Rober	271	RMNH
<i>Epipagis ocellata</i> (Hampson 1916)	1m	Congo: Lulua	307	RMCA
	1f	Congo: Bokuma	308	RMCA
<i>Eurrhypis pollinalis</i> (Denis & Schiffermüller 1775)	1m, 1f	[illeg.] Hamfelt Coll.	132, 133	USNM
<i>Hemiscopis suffusalis</i> (Walker 1866 [1865])	1m, 1f	Philippines: Los Baños	196, 320	USNM
	1m	Philippines: Mindanao	417	CNC
	1m	Sri Lanka: Kandy	1652 EGM	CNC
	1f	China: Hainan Is.	78	CUIC
<i>Heortia dominalis</i> (Lederer 1863)	1f	Sri Lanka: Colombo	1653 EGM	CNC
	1m, 1f	Philippines: Mindanao	324, 325	RMNH
<i>Heortia vitessoides</i> (Moore 1885)	1m	Cambodia	75	CUIC
	1m	Sri Lanka: Galle Distr.	326	USNM
	1f	Sri Lanka: E. Distr.	152	USNM
	1m	Indonesia: Borneo	2555 EGM	CNC
<i>Hyalinarcha hyalinalis</i> (Hampson 1896)	1m	PNG: Dagua Rd., Wewak	115	CNC
	1f	PNG: Morobe	116	CNC
	1m	PNG: Wewak	3028 DK	CNC
	2m	India: Assam: Margherita	3024 DK, 3032 DK	CNC
<i>Hydrorybina polusalis</i> (Walker 1859)	1m	Laos	74	CUIC
	1f	Sri Lanka: Kandy	4819 DK	CNC
	1f	Philippines: Luzon	321	ZMHIB
	1m	Madagascar: Analamazaotra	279	MNHIN
<i>Mecyna catalalis</i> Viette 1953	1f	Madagascar: Anosibe route	280	MNHN
	1m, 1f	Guyana: Rupununi	51, 52	USNM
<i>Mecynarchia apicalis</i> (Hampson 1898)	1f	? Ellsworth Collection	155	CUIC
	1m	Brasil: Amazonas	161	CMNH
	1m, 1f	USA: Virgin Is.: Kingshill	57, 58	CUIC
	1m	USA: AZ: Pima Co.	87	CUIC
<i>Mimoschinia rufofascialis</i> (Stephens 1834)	1f	USA: TX: Uvalde	88	CUIC
	1f	Mexico: B.C. Sur	272	CMNH
	1m, 1f	New Guinea: Irian Barat	249, 250	ZSM
	1m, 1f	Malaysia: Sabah	197, 204	USNM
<i>Pseudonoorda brunneiflava</i> Munroe 1974	1f	Indonesia: N. Sulawesi	261	RMNH
<i>Pseudonoorda</i> sp. near <i>brunneiflava</i> Munroe 1974	1m	Philippine Is: Luzon	260	MTD
<i>Pseudonoorda distigmalis</i> (Hampson 1913)	1m	Cameroon: Efulen	20	CMNH
	1m, 1f	Cameroon: Efulen	117, 118	CNC
	1m, 1f	USA: Arizona	139, 140	CUIC
	1m	Venezuela: Amazonas	141	CUIC
<i>Pseudoschinia elautalis</i> (Grote 1881)	1m, 1f	Brasil: Amazonas	142, 143	CUIC
	1m	Brasil: Téffé	1117 M. d'A.	CNC
	3m, 1f	Bahamas: Great Exuma	186, 187, 188, 274	CUIC
	1m	Cuba: Holguín	273	MTD
<i>Tegostoma comparale</i> (Hübner)	1m, 1f	S. Russia	27, 28	USNM
<i>Viettessa bethalis</i> (Viette 1958)	1m	Cameroon: Bonenza	264	RMCA
	1f	Congo: Paulis [Isiro]	319	RMCA

a Dell Latitude D610 PC. The commands were “rseed 1; hold 1000; collapse auto; mult= hold 10 replic 20;” The same commands can be implemented by selecting Settings / Memory / Max. trees = 1000, then entering search parameters under Analyze / Traditional Search. “Collapsc auto” ensures that branches with no apomorphies are collapsed.

During preliminary character analysis, additivity was explored for some characters, and results that implied homoplasy in complex characters were reanalyzed. In final analysis, characters were treated as non-additive and equally weighted, and polarity was determined from the results of unconstrained analysis with *C. dentalis* as the primary outgroup (Nixon & Carpenter 1993). Inapplicable data are represented by “-” and missing data by “?,” but both are analyzed allowing all possible states to be considered. The matrix was analyzed as-is, but to assess tree length correctly, a second matrix was analyzed where the polymorphic terminals were divided into multiple terminals (Nixon & Davis 1991).

The apomorphies of terminals and clades are interpreted to be their diagnoses (Farris 1979). Character evolution was traced with the Character Diagnoser function of WinClada and TNT. Fast and slow optimization herein respectively refer to accelerated and delayed transformation (Swofford & Maddison 1987) and were implemented with WinClada. Bremer support values for clades were calculated by expanding memory for trees, generating many

suboptimal trees up to N extra steps, and searching among those for the shortest tree that lacks a given node (“hold 80000; subopt N ; bbreak=fillonly; bsupport”).

The values of missing data were predicted to be those that best agree with the optimality criterion in simultaneous analysis. For parsimony, this is all possible permutations for unscored cells that add no extra steps. See Wilkinson (1995: Table 1) for an antecedent. Possible states were restricted to those actually observed in scored taxa. Predictions were made by inspecting mapped characters with WinClada, then running a simple procedure file in TNT to check the ambiguous cases. The file, available from the author, uses the “xread =” command to replace “?” with alternative states.

RESULTS

Phylogenetic analysis. Searches found 1 tree of 187 steps (consistency index = 0.35, retention index = 0.67) (Fig. 7). Most of the cells coded for more than one state represent uncertainty of state assignment. There are four real polymorphisms: the wing pattern (char. 4) of the new species and the composite *Pseudonoorda brunneiflava*, and the feeding habit (char. 47) of two other species (Table 2, footnotes). Splitting these four into eight terminals, each pair differing only in the state of the polymorphism, resulted in the same topology with length 191. Branches without support are collapsed as polytomies. Character state changes are reported in Appendix C.

TABLE 2. Sources of hostplant data.

Species	References
<i>Autocharis barbieri</i>	Gerlach and Matyot 2006
<i>Autocharis fessalis</i>	Beeson 1961, Browne 1968
<i>Cliniodes opalalis</i>	Janzen & Hallwachs 2005
<i>Cliniodes ostreonalis</i> [°]	McDunnough 1931, Munroe 1961, Hayden 2008
<i>Cynaeda dentalis</i>	Slamka 2006, Huertas Dionisio 2007
<i>Deanolis sublimbalis</i>	Waterhouse 1998
<i>Dicepolia roscobrunnea</i>	de Oliveira 1942 [1941]
<i>Eurrhypis pollinalis</i>	Slamka 2006, Huertas Dionisio 2007 (for <i>E. guttulalis</i> (Herrich-Schäffer))
<i>Hemiscopis suffusalis</i> ^{°°}	Beeson 1961, Tominaga 1999, Turner 1908
<i>Heortia vitessoides</i>	Munroe 1977, Singh <i>et al.</i> 2000
<i>Hydrorybina polusalis</i>	Meyriek, E. 1938 MS, in Robinson <i>et al.</i> 2001
<i>Mimoschintia rufofascialis</i>	Heinrich 1921, Leech 1949
<i>Pseudoschinia clautalis</i>	Mann 1969
<i>Tegostoma comparale</i>	Huertas Dionisio 2007

[°] Folivore on Thymelaeaceae and Rhamnaceae. Coded as polymorphic.

^{°°} *H. suffusalis* on Dipterocarpaceae and Phyllanthaceae, but *H. purpureum* (Inoue) and *H. violacea* (Lueas) on Thymelaeaceae. Phyllanthaceae produce alkaloids like those in Thymelaeaceae. Coded as polymorphic.



FIG. 7. Cladogram (187 steps, CI = 0.35, RI = 0.67). Numbers above branches refer to nodes (Appendix C), and numbers below are Bremer support values (suboptimality of trees lacking the node). NA, Nearctic; NT, Neotropical; PA, Palaearctic; PT, Palaeotropical; E, Eurrhypini; L, leaf-feeding clade; S, sepiform clade. **A. margarita* is also known from Madagascar (Munroe 1974). ***C. ostreonalis* is Eastern Nearctic.

The sepiform clade (node 64, S) is strongly supported as monophyletic, with Bremer support of 5 (i.e. the next shortest trees from which the clade is absent are 5 steps longer) (Bremer 1988). The clade has five unambiguous apomorphies: lamelliform structures absent (21:0), sepiform structures present (22:1, uniquely derived), distal edge of squamiform structures rounded (26:1, uniquely derived, reversed to squarish in the *Pseudonoorda brunneiflava*-group), squamiform structures with central enations (27:1), cervix bursae

large and sclerotized (40:2).

The new species is the first-diverging terminal in the sepiform clade. The Palaeotropical species that constitute the remainder of the clade (node 63) share three unambiguous synapomorphies: Rs_1 stalked with Rs_{2+3} (11:1), loss of S8 piluli (23:0), and elongate ovipositor (38:1). The results indicate that *Pseudonoorda* is paraphyletic.

The sister group of the sepiform clade (node 42, L) includes medium- to large-bodied species of global

distribution. The clade's two apomorphies are an extension of the forewing costal streak through the discal spot that approximates or reaches the postmedial line (6:1) and the shallow depth of the sacci tympanorum extending underneath S2 (15:1). The group includes several members that feed on Thymelaeaceae, a plant family that produces unusual toxic terpenoid compounds (Evans 1986).

Deactivation of char. 47 (feeding habit) results in almost no change. Three trees of 183 steps are recovered that differ in minor aspects that do not affect the sepiform clade, thymelaeacean clade, or any nomenclatural conclusions drawn here. Combining states 2 and 3 into one state (general folivory) returned the same topology with one fewer step.

Systematic section. *Clupeosoma orientalale* (Viette) **comb. nov.** and *Clupeosoma vohilavale* (Marion & Viette) **comb. nov.** are transferred from *Autocharis*, as they share synapomorphies with *Clupeosoma* *sensu* Munroe (1974b) (see Discussion). *Hyalinarcha hyalinalis* (Hampson) **comb. nov.** is transferred from *Boeotarcha* Meyrick, as it is closely related to the type species *H. hyalina* (Hampson), females of which were not available for study. *Noordodes magnificalis* (Rothschild) **comb. nov.** is transferred from *Noorda* Walker.

The synonymy of *Basonga* Möschler, 1886 (type species *B. paradisalis* Möschler) with *Cliniodes* Guenée, 1854, last recognized in Klima (1939), is revived, as is the combination *Cliniodes paradisalis* (Möschler). *Metrea* Grote, 1882 is synonymized with *Cliniodes*, **syn. nov.**, resulting in the combination *Cliniodes ostreonalis* **comb. nov.**

Suinoorda Hayden **gen. nov.**

Diagnosis. Unambiguous autapomorphies: female with entire forewing solid orange, concolorous with terminal area (4:1, 2; Fig. 2); lateral arms of gnathos approximated to lower corners of uncus (36:1).

Symplesiomorphies not shared with rest of sepiform clade: forewing Rs_1 not stalked with Rs_{2+3} (char. 11:0; Fig. 10); piluli present on S8 (char. 23:1; Fig. 12: Pi); androconium of long, straight setae present near base of valval costa, dorsal side (28:1; Fig. 18: BA); ovipositor short (38:0; Fig. 16). Otherwise sharing the apomorphies of the sepiform clade of Eurrhypini (see above).

Two other diagnostic characters have ambiguous optimization: forewing antemedial line absent (8:0, autapomorphic with slow optimization or synapomorphic with fast optimization); basicostal androconium present as field of deciduous hairs from

base of costa (28:1, Fig. 18: BA; autapomorphic with slow optimization or symplesiomorphic with fast optimization).

Etymology: Latin *sus*, swine, referring to the shape of the frontoclypeus, and also the reflexive pronoun, referring to taxonomic rank; plus *Noorda* Walker. Gender, feminine.

Type species: *S. maccabei* Hayden **sp. nov.**

S. maccabei Hayden **sp. nov.**

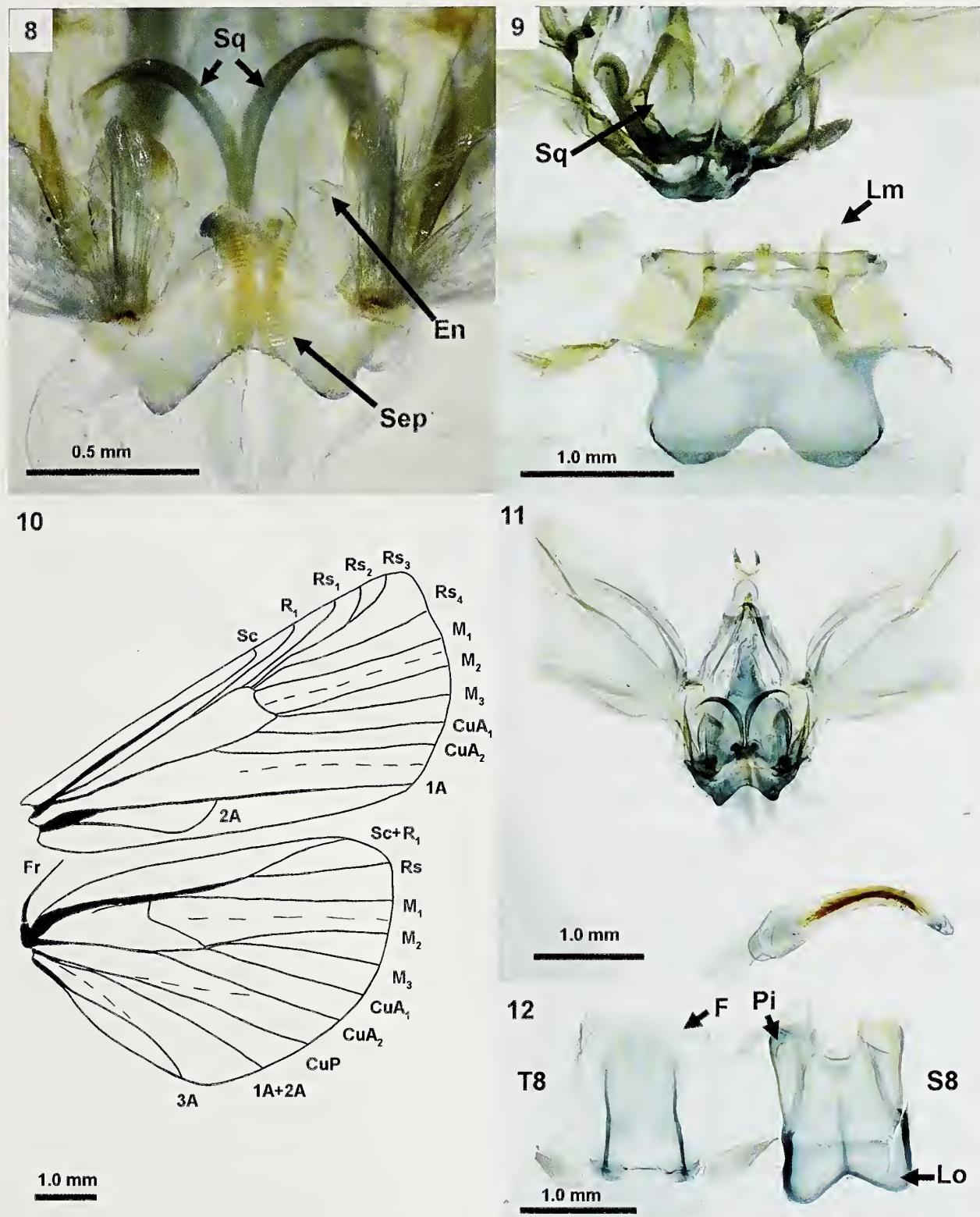
Description. Male habitus (figs 1, 5, 13, 14, 15): **Head.** Frons flat and oblique. Frontoclypeus expanded in a low cylindrical protuberance, lateral edges of ridge curling down and inward almost to secondary contact above pilifers; lower edges of frontoclypeus crenulate (fig. 5: Fc). Frons with smooth, yellow-beige scales, dark brown laterally on protuberance. Vertex rough, yellow-beige. Scales between antennae and eyes white. Ocelli present. Chaetosemata absent. Antennae round and smooth, about 3/5 length of forewings, cilia dense and longer than in female. Labial palpi dark brown above, white below; not greatly exceeding length of head, length 0.90 ± 0.03 mm from base under head to apex; porrect or slightly drooping with third meron downturned $\sim 30^\circ$ from porrect axis. Maxillary palpi short (0.36 ± 0.03 mm), brown, terminal scales not strongly dilated. Pilifers small and separate from lower corners of frontoclypeus. Haustellum well-developed, basal vestiture white.

Thorax. Collar, distal tegulae and dorsal thorax yellow-beige. Tegulae proximally brownish red. Ventral thorax and coxae white. Forelegs: coxa white mixed with light gray, with patch of long, yellow-gray, backward-sweeping hairs extending the length of anterior margin of coxa (fig. 5: CH); femur and tibia gray, the latter with epiphysis hidden in long scales, without androconium; tarsomeres white, all but the basal one with small dorsal gray patch. Midlegs: femur and inner surface of tibia white; outer tibial surface orange fading to yellow before white, with gray patch at joint with femur; tibia bearing androconium of straight, white hairs as long as tibia (fig. 14: An); inner tibial spur 3 times length of outer; tarsi as for foreleg. Hindlegs: uniformly white, no androconia; spurs as fore midleg; tarsi as for foreleg.

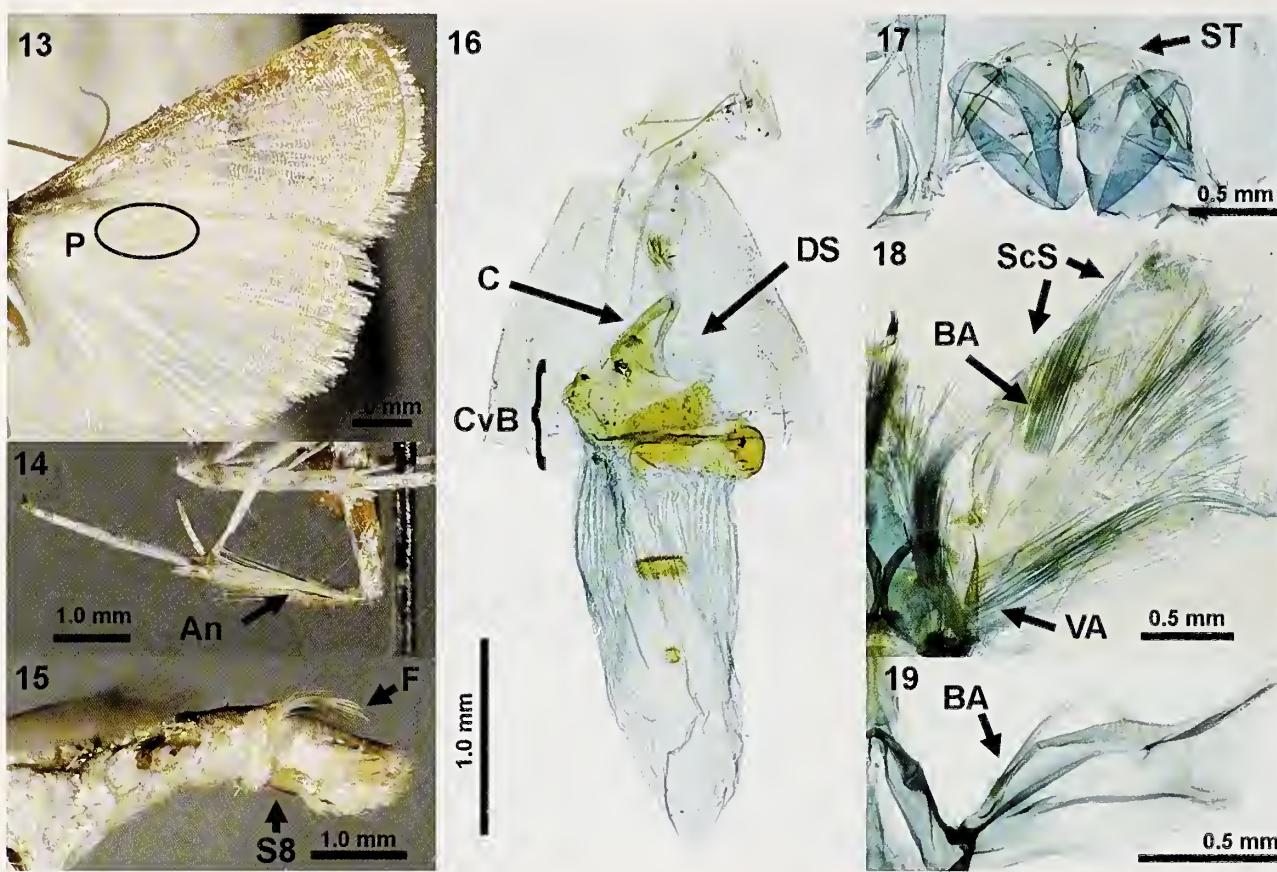
Abdomen. Praecinctatorium white-scaled, monolobate, as broad as deep. Abdomen dorsum yellow (hindmost scale row white), venter white. Male abdomen 4.8 ± 0.1 mm in length excluding genitalia. Genitalic androconia pale yellow. Eighth sternite without scales (fig. 15: SS).

Forewing. Length, $7.2 - 7.7 \pm 0.1$ mm, width, $3.6 - 4.0 \pm 0.1$ mm ($n = 6$). Upper side pale yellow with scales tipped in yellow, salmon or fuscous, giving irrorate appearance in fresher specimens. Costa thickly scaled and colored, with longer, setiform scales on edge; proximally gray along leading edge; distally and inner proximally dark salmon-orange. Antemedial line represented by minuscule brown spot behind costa at 1/5 length and faint spot or line along dorsal edge at 3/8 length. Discal spot large, oval, dark brown, beyond 1/2 length of wing, 0.42 ± 0.06 mm wide by 0.66 ± 0.06 mm long. Postmedial line narrow, dark brown, smoothly curving convexly from costa (at Rs_4) to CuA_1 and concavely from CuA_2 to tornus. Postmedial area 1.0 ± 0.1 mm wide, orange or dark salmon. Terminal fringe dark gray or fuscous. Dorsal edge of forewing without scale tufts. Fovea absent. Forewing underside pale yellow, with costa and terminal area orange. Male-type retinacular hook and female-type retinaculum both present.

Hindwing. Length, 6.2 ± 0.1 mm by 3.6 ± 0.1 mm; lustrous white, with long, sparse hairs on anal area. Anal edge smoothly curved. Terminal area pale orange with some scales brown-tipped in darker specimens. Postmedial line faint, brown, from M_2 to anal fold, where it meets the terminal edge; white behind anal fold (a few brown scales extend proximally along anal fold in fresher specimens). Terminal fringe yellowish brown. Hindwing underneath translucent white, with yellow costa and terminal fringe. Male frenulum a single bristle.



FIGS. 8-12. Genitalia and wings. **8**, *Suinoorda maccabei* ♂ genitalia, stridulatory apparatus (JEH 187). **9**, *Cliniodes ostreonalis* ♂ genitalia, stridulatory apparatus, squamiform structures slightly displaced (JEH 137, CNC). **10**, *S. maccabei* ♂ wing venation (JEH 274). **11**, *S. maccabei* ♂ genitalia, entire (JEH 187). **12**, same, eighth abdominal segment. **En**, enation of squamiform structure; **Sq**, squamiform structures; **Sep**, sepiform structures; **Sc**, squamiform structures; **Fr**, frenulum; **Lm**, lamelliform structure; **Lo**, lobe of S8; **Pi**, location of piluli; **T8**, eighth tergite; **S8**, eighth sternite.



Figs. 13–19. Habitus and genitalia. 13, *Suinoorda maccabei* underside of ♂ wings. 14, *S. maccabei* ♂ mesothoracic tibia, lateral aspect. 15, *S. maccabei* ♂ abdomen, lateral aspect. 16, *S. maccabei* ♀ genitalia (JEH 188). 17, same, tympanal organs. 18, *S. maccabei* ♂ genitalia, dorsal aspect (JEH 187). 19, *Autocharis barbieri* ♂ genitalia, ventral aspect (JEH 94, USNM). **An**, androconium of long hairs; **BA**, basicostal androconium; **C**, colliculum; **CvB**, cervix bursae; **DS**, ductus scimalis; **F**, tergum 8 posterior fringe; **P**, patch of scales on hindwing subcostal area; **ScS**, scoop-shaped scales along costa; **ST**, saccus tympani; **S8**, sternite 8 (naturally denuded); **VA**, vincular androconium.

Dense patch of small, erect scales between costa and Sc+R, from base of wing to the divergence of Sc+R₁ and R₅; patch extended discretely but more sparsely onto anterior half of discal cell (fig. 13: P).

Female habitus (fig. 2): Structure and coloration as in male, except dorsum of head, thorax and forewings almost uniformly salmon-orange. Tegulae and lateral collar dark brown; midleg tibia upper surface more strongly orange, without androconia. Antennal cilia shorter than in male, but antenna itself of same thickness. Forewing medial and terminal areas concolorous, with the latter slightly more densely scaled. Forewing antemedial line absent; discal spot and postmedial line indistinctly indicated by light-brown scales. Retinaculum a patch of scales as in male. Two frenular bristles. Hindwing underside without subcostal patch of scales. Hindwing terminal area darker yellow than rest of hindwing, but lines absent. Abdomen 4.4±0.2 mm in length excluding ovipositor; exceeding hindwings by about one third length.

Venation (fig. 10): *Forewing*: Sc meeting margin 2/3 from wing apex. R₁ basally straight and moderately broadened. R₅ basally straight, not stalked with R₂₊₃. R₂₊₃ with stalk curved to approximate R₅ closely. Sc and radial veins except R₅ distally curved toward anterior margin, the first three veins suddenly and sharply so. R₄ unstalked, basally curved toward R₂₊₃ distally meeting margin below wing apex. Cell complete, 7/12 length of wing. M₁ nearly straight, from upper corner of discal cell. M₂ and M₃ straight, from lower corner of cell. CuA₁ and CuA₂ straight, arising from cell basad from tip. 1A straight, complete; 2A looped and joining 1A at half its length.

Hindwing: Sc+R₁ stalked to about 1/3 length from point of departure from cell, partly joined to R₅ to just beyond discal cell. Base of Sc+R₁+R₅ strongly broadened. Discal cell short: anterior portion 1/3 length of wing, distally demarcated by short, straight spur of M₁ parallel to body axis; posterior portion demarcated by straight vein running diagonally to nearly 1/2 length of wing. M₁ straight. M₂ and M₃ basally approximate, not stalked, from lower corner of cell. CuA₁ from corner of cell; CuA₂ from cell at just more than 2/3. CuP and 1A+2A straight; 3A basally straight and broad, distally slightly bowed anteriad before meeting margin.

Tympanal organs (fig. 17): Bullae tympani oval, length twice width. Edges of fornia tympani straight and meeting in blunt, elbow-like right angle. Sacci tympani round, not hypertrophied (fig. 17: ST); rami tympani (transverse edge) on same level as elbow of fornia tympani. Processus tympani a broad, nearly circular lobe. Puteoli tympani shallow. Venulae not evident. S2 a rounded rhombus, wider than long, bluntly protruding over S3; median third of S2 also emergent and slightly more sclerotized than lateral areas.

Male genitalia (figs 8, 11, 12, 18): *Eighth segment*. T8 membranous, longer than wide; lateral sclerotized edges of T8 with anterior ends ending in shallow, posteriad-facing invaginations, posterior ends fading before fringe; transverse bar absent. Transverse fringe of long, broad, keeled scales present along posterior edge of T8 (figs 12, 15: F). Lateral ends of fringe separate as distinct lobes in pleuron 8, slanted dorso-anterior to ventro-posterior and closely adjacent to posterior corners of S8. S8 roughly rectangular, parallel-

sided; anterior quarter underneath S7 and bilobate, with broadly triangular emargination and medially sclerotized to half way point. Edges sclerotized, most strongly along anterior third. Posterior edge with squared corners and central third broadly, roundly emarginate, without projections. Central area of S8 trapezoidal, slightly raised, with corners at sternal margin at anterior third to posterior emargination. Postero-lateral corners of S8 with area of fine nondeciduous setae (piluli, char. 22; fig. 12: Pi). Lamelliform structures absent. Androconia of pleuron 8 on large, lance-ovate patches; dorso-anterior end rounded and adjacent to anterior corners of T8, ventro-posterior end tapered and connected directly to the sides of S8 at the point where S8 emerges from underneath S7.

Genitalia. Uncus an isosceles triangle about twice as high as width at base, with expanded, flat-topped, bilobate apex bearing conspicuous tufts of nondeciduous setae at tip of each lobe; rows of fainter hairs on lateral edges of uncus, but elsewhere bare. Arms of gnathos transversely straight, with broad bases fused to tegumen and medial area narrow; bases of gnathos arms close to base of uncus. Gnathos central element parallel-sided, produced $210 \pm 15 \mu\text{m}$, with minute granules at bluntly acute tip; ventrally deeply indented beyond (posterior of) the level of the arms. Tegumen almost as long as vinculum ($680 \pm 15 \mu\text{m}$), without ornamentation; with long, straight-sided lateral arms descending to valvae. Membrane between arms with diffuse deciduous hairs, not grouped into discrete patches. Juxta smooth, occupying most of the area inside vinculum and sides parallelling edges of vinculum; base nearly circular, as high as squamiform structures, with concave emargination where base of vinculum bows upward; apex of juxta abruptly cuspidate and acute, unornamented and not projecting. Valvae lyriform, $1,770 \pm 15 \mu\text{m}$ along costa. Costa sinuate, proximally convex and distally concave, edge basad of apex membranous and bearing short, smooth, unkeeled scales that curve over edge of costa (fig. 18: ScS). Costa sclerotized to apex, with small tuft of short setiform hairs on a slightly out-turned apex. Distal edge of valva straight. Saccular edge of valva roughly mirroring costa: subapically concave, medially convex, and basally indented to accommodate squamiform structures. Convex area of sacculus with dense, broad scales. Medial area of valva basally sclerotized and distally membranous with striae and sparse, fine setae. Area below costa longitudinally depressed as narrow, shallow pocket. Reverse side of valva with androconium $380 \pm 15 \mu\text{m}$ from base of valva, in submarginal position (behind shallow pocket); base of field a transverse row, $150 \pm 15 \mu\text{m}$ long (fig. 18: BA). Vinculum $1,050 \pm 20 \mu\text{m}$ high, roughly square. Transtilla absent. Saccus not developed, medially concave. Androconia present lateral of vinculum, of straight hairs as long as valvae (fig. 18: VA). Basal area of androconia extended to $500 \pm 15 \mu\text{m}$ in length, running up behind (dorsal of) vinculum toward tegumen. Phallus $1,680 \pm 15 \mu\text{m}$ long, $170 \pm 15 \mu\text{m}$ at narrowest point, gently curved. Vesica with numerous small cornuti along most of length.

Squamiform and associated structures. Posteroventral vinculum (facing juxta) with medial, sclerotized, bicapitate boss. S8-9 intersegmental membrane extended over vinculum, bearing squamiform structures lateral of boss. Medial pluma of unkeeled scales not obvious. Membrane laterally extended as semi-sclerotized arms bearing short tufts of scales parallel to lateral edges of squamiform structures. Membrane anteriad of vinculum with thickened pair of longitudinal, parallel fields bearing transverse ridges at intervals of about $15 \mu\text{m}$ (fig. 8: Sep). Ridged fields narrow, each $45 \pm 15 \mu\text{m}$ wide and $450 \pm 15 \mu\text{m}$ long, with further sclerotization extending $250 \pm 15 \mu\text{m}$ anteriad. Squamiform structures round, $675 \pm 15 \mu\text{m}$ long by $400 \pm 15 \mu\text{m}$ wide, symmetrical; stiff membranes attached on lower edge to vinculum (fig. 8: Sq). Medial edge of squamiform structures strongly sclerotized and smoothly arcuate in hemiellipse extending over distal end of squamiform structures. Lateral edges clavate and longitudinally striate, with narrow base and broad termination before membranous laterodistal area that does not meet the arc of the medial edge. Central area of squamiform structures finely striate. Basicentral area of each squamiform structure with digitate process or enation directed medially, adjacent to boss of accessory sclerite (fig. 8: En). Enations curving around

ridged areas when the latter are folded against them.

Female genitalia (fig. 16): Ovipositor short, $750 \pm 15 \mu\text{m}$ long by $450 \pm 15 \mu\text{m}$ deep, with A9 not longer than deep. Ovipositor lobes soft and truncate. Anterior apophyses extending to colliculum; posterior apophyses not extending beyond anterior edge of A9. Colliculum short, about twice as long as wide (fig. 16: C). Ductus bursae between colliculum and corpus bursae proper expanded in an irregularly chamber (cervix bursae: CvB), demarcated from corpus bursae by slight constriction and end of sclerotization. Cervix bursae irregularly but mostly sclerotized. A few granular hooklets irregularly distributed on the signum. Ductus seminalis narrow and arising from unsclerotized area of anterior ductus bursae (DS). Corpus bursae proper (anterior of sclerotized cervix) $1900 \pm 30 \mu\text{m}$ long, longitudinally pleated and bearing two convex, granular signa on opposite sides of the bursa, the larger and posterior of the two being transversely ovate, and the anterior one nearly circular.

Type material. Holotype. ♂: BAHAMAS—Great Exuma—Simons Pt, 23.31.50—75.47.30, 12 April 1986, Tim L. McCabe / [red label] HOLOTYPE *Suinoorda maccabei* Hayden. T.L. McCabe Collection. **Paratypes.** BAHAMAS: 1♂, same data as holotype except: 10 April 1986 / J.E. Hayden Slide No. 187 ♂ (JEH Coll.). 1♂, same data as holotype except: 14 April 1986 / J.E. Hayden Slide Nos. 186 ♂, 274 wings (CUIC). 2♂♂, same data as holotype except: 15 April 1986 (CUIC and T.L. McCabe Collection). 1♀, same data as holotype except: 15 April 1986 / J.E. Hayden Slide No. 188 ♀ (CUIC). CUBA: 1♂: [green label] Cuba, Holguín, Rafael Freyre, Piedra Pícar, dry forest, 9.vi.2000, leg. J.-P. Rudloff / J.E. Hayden Slide No. 273 ♂ (MTD). CUIC type no. 7356.

Diagnosis: As for genus.

Biology: Unknown. See Missing Data.

Distribution: Commonwealth of the Bahamas: Great Exuma Island; Republic of Cuba: Holguín Province (fig. 20).

Etymology: I take pleasure in naming this species after Dr. Tim McCabe, Curator of Entomology at the New York State Museum, who collected and finely set the Bahamian series.

Variation: The Cuban specimen differs from the Bahamian ones in having a slightly narrower frontoclypeal arch and the lateral arms of the gnathos at a slightly more obtuse angle to the median element. These features are not of specific distinction.

Similar species: *Suinoorda* differs from similar species in the possession of a highly, almost circularly arched frontoclypeal margin. *Autocharis* and *Dicepolia* have an obtusely to acutely angulate frontoclypeus, and *Noordodes* and *P. brunneiflava* have a low, rounded arch. *S. maccabei* also differs in the sexually dimorphic forewing coloration, and the sharp apical curvature of the forewing radial veins is unique. Similar species outside the sepiform clade lack the sepiform structures.

Among similar Neotropical Eurrhypini, *Dicepolia* species have long labial palpi, are uniformly colored brownish orange or rosy brown, and have a dark, narrow postmedial line farther from the terminal margin. Female *S. maccabei* differ in having no trace of ante- and postmedial lines. *Cliniodes paradisalis* (fig. 4) has short, upturned labial palpi typical of *Cliniodes*. Both have a smooth postmedial line, but it extends much farther basad along the posterior wing margin in *C.*



FIG. 20. Known distribution of *S. maccabei*. Starred localities: Simon's Point, near Georgetown, Great Exuma Island, Bahama Is., and near Rafael Freyre, Holguín Province, Cuba.

paradisalis, approximating the obvious antemedial line. The forewing has a discal spot continuous with the costal streak, and the hindwing is suffused more strongly. *Argyrarcha* and *Sobanga* differ strongly from *S. maccabei* in maculation, including a well-developed antemedial line and the costal streak extending through the discal spot toward the postmedial line. These also have an expanded T8 posterior fringe, which in *Argyrarcha* and *Mecynarcha* Munroe is cape-like and larger than any single tergite.

Among Palaeotropical genera, the red-and-white *Autocharis* species have long labial palpi, some (*A. fessalis* Swinhoe) have hindwing M_{2+3} stalked, and some have a more strongly developed spot of color on the hindwing anal vein. In *Autocharis* species, the shape of the forewing postmedial line tends to be more angulate on the veins. *Pitana herunesalis* and *Viettessa* have a straight frontoclypeus, a much broader postmedial band, and most species are much larger in size. Like some of the Neotropical taxa, *Viettessa* species have a costal streak extending through the discal spot toward the postmedial line. *Pseudonoorda brunneiflava* and *Noordodes* have Rs_1 stalked with Rs_{2+3} . *Noordodes* has a postmedial line that steps sharply basad along the cubital veins. The ground color is yellow and the markings, dark violet.

Character evolution. The four unambiguous symplesiomorphies of *Suiuorda* argue for its early divergence. The frontoclypeal arch (char. 3:2, figs 5, 6) evolved once or twice from a transversely straight margin (3:0), depending on fast or slow optimization: in the last common ancestor of *Hyalinarcha* and *Suiuorda* (fig. 7: node 44) or independently in nodes 52 and 64. The length of antennal sensilla (char. 0) is informative: except for four autapomorphic reversals, it characterizes nodes 43 and 56, and has $ci = 0.42$, $ri = 0.78$.

Forewing maculation with a white or light-colored median and distinctly darker terminal area (4:1) evolved one to three times from states 0 or 2 and was lost several times. It appeared above *T. couparale* (node 46) and was retained as the fundamentally plesiomorphic condition along most of the phylogeny. Under slow optimization, it evolved once at node 46, but under fast optimization, it evolves independently in *C. paradisalis* and *Autocharis* (node 50). The concolorous maculation in both female *S. maccabei* and *Pseudonoorda* sp. near *brunneiflava*, regarded as split terminals, is recovered as independent reversals from the white/red condition. The stalking of Rs_1 with Rs_{2+3} (char. 8:1) is mainly a feature of the sepiform clade above *Suiuorda* (node 63), but it evolved independently in *Hydrorybina*.

Some species lack the stridulatory apparatus. Lamelliform structures (21:1; fig. 9: Lm) were gained with the Eurrhypini (node 46) and lost in *S. rutilalis* and the sepiform clade. Likewise, the squamiform structures (square membranes: char. 24; figs 8, 9: Sq) were gained at node 46 and lost in *S. rutilalis*, rendering characters 25, 26, and 27 inapplicable. The outgroup *Cynaeda dentalis* is classified in Odontiini, which is defined by the absence of the lamelliform and squamiform structures (Leraut & Luquet 1983).

The S8 piluli (char. 23) were gained at node 46 (Eurrhypini) and lost at nodes 41 (the *Aeglotis*-*Argyrarcha* clade), 63 (the sepiform clade above *Suiuorda*), and in *H. hyalinialis*. Some but not all of these clades have the stridulatory apparatus absent or modified (e.g. asymmetrical squamiform structures at node 47, evolved from symmetrical structures). The basicostal androconium on the dorsal side of the costa of the male valve (28:1; figs 18, 19: BA) evolved from the absent condition (28:0) at node 44, the last common ancestor of *Hyalinarcha*, *Suiuorda*, and *Aeglotis*. It was secondarily lost at nodes 41, 63, 53 (*Cliuodes* spp.), and in *M. catalalis*. An androconium situated halfway along the costa, at the end of a sclerotized extension (28:2), is a synapomorphy of derived *Cliniodes* species (node 57), and it evolved from the absent condition. A gnathos with arms basally approximate to the lower uncus (36:1) evolved three times from the not-approximated condition (36:0) at nodes 47, 53, and in *Suiuorda*.

The ovipositor length (char. 38) is homoplastic ($ci = 0.12$), but it contains some grouping information ($ri = 0.46$). It is long in the Palaeotropical sepiform species, but its short length in *Suiuorda* contributes to grouping that clade with the large-bodied species of node 42.

Stem boring and leaf mining (47:0) is the primitive eurrhypine feeding habit, and it is restricted to the outgroups (Odontiini) and *Eurrhypis* Hübner and is predicted for *Ephelis*. Seed- or fruit-feeding (47:1) evolved from it and is the most general larval feeding habit. It is known for the three distantly related groups *Munoschinia* Munroe + *Pseudoschinia* Munroe, *Dicepolia roseobrunnea* (Warren), and *Deanolis*, and predicted for the intervening taxa. External folivory on Thymelaeaceae (47:2) is restricted to the clade of node 42 and evolved once or twice from seed-feeding, in *Hemiscopis* and in node 54, or earlier depending on optimization. Folivory on other plant families (47:3) evolved independently from seed-feeding in *Autocharis* and from either seed- or Thymelaeaceae-feeding in *Hemiscopis* + *Hydrorybina*. Predictions for unscored data are reported in Table 3.

TABLE 3. Predicted missing data. The following states add no extra steps to the cladograms when analyzed together.

Species	Character	Predicted states
<i>A. argentalis</i>	38. Ovipositor length	short
	39. Colliculum	short
	40. Duet. burs. sclerotization	absent
	41. Appendix of duet. burs.	absent
	42. Corp. burs. signum	present (one or two)
	43. Corp. burs. signum, shape	round
	44. Ductus seminalis origin	from ductus bursae
	45. Ductus seminalis width	narrow
	46. Pleats on cervix bursae	absent, or present
	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
		seeds/fruits, or folivore on Thymel., or folivore on other family
<i>A. margarita</i>	47. Feeding habit	folivore on other family
<i>A. albipлага</i>	47. Feeding habit	present
<i>A. barbieri</i>	31. Vincular androconia	seeds/fruits
<i>A. mimetica</i>	47. Feeding habit	folivore on Thymel.
<i>C. costimacula</i>	47. Feeding habit	folivore on Thymel.
<i>C. paradisalis</i>	47. Feeding habit	folivore on Thymel.
<i>C. atristriatum</i>	38. Ovipositor length	long
	39. Colliculum	short
	40. Duet. burs. sclerotization	absent
	41. Appendix of ductus bursac	absent
	42. Corpus bursae signum	present (one or two)
	43. Corp. burs. signum, shape	round
	44. Ductus seminalis origin	from ductus bursae
	45. Ductus seminalis width	enlarged
	46. Pleats on cervix bursae	present
	47. Feeding habit	seeds/fruits
<i>C. orientalale</i>	47. Feeding habit	seeds/fruits
<i>C. sericiale</i>	47. Feeding habit	seeds/fruits
<i>C. volhilavale</i>	47. Feeding habit	seeds/fruits
<i>D. munroealis</i>	0. Antennal sensilla	longer in male
	31. Vincular androconia	absent
	47. Feeding habit	seeds/fruits
<i>D. rufitinctalis</i>	47. Feeding habit	seeds/fruits
<i>E. cruentalis</i>	47. Feeding habit	stem borer or leaf miner
<i>E. ocellata</i>	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
<i>H. dominalis</i>	47. Feeding habit	folivore on Thymel.
<i>H. hyalinalis</i>	47. Feeding habit	seeds/fruits
<i>M. catalalis</i>	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
<i>M. apicalis</i>	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
<i>N. magnificalis</i>	47. Feeding habit	seeds/fruits
<i>P. hermesalis</i>	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
<i>P. brunneiflava</i>	47. Feeding habit	seeds/fruits
<i>P. distigmatis</i>	47. Feeding habit	seeds/fruits
<i>S. rutilalis</i>	31. Vincular androconia	present
	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family
<i>S. maccabei</i>	47. Feeding habit	seeds/fruits
<i>V. bethalis</i>	47. Feeding habit	seeds/fruits, or folivore on Thymel., or folivore on other family

DISCUSSION

The recent collection of this new species recalls Hampson's comment on the Bahamian moth fauna: "[...] I should expect a thorough exploration of the other islands [than Nassau and Andros] to add considerably to the list of species" (1901). Hampson studied only specimens from those islands and Abaco (1901, 1904); had he seen it, he probably would have assigned it to *Noctuelia* Guenée or *Noorda* Walker following his classification of Pyraustinae (Hampson 1899a). I find no reference to a species fitting this description in other studies of Bahamian and Cuban Lepidoptera (Smith *et al.* 1994 and citations therein).

The distribution of this species in the Bahamas and Cuba (Fig. 20) can be explained by the subaerial exposure of the Bahama Platform during the last glacial maximum, when the islands were separated by only the narrow Old Bahamas Passage (Miller & Miller 2001). The Cuban locality is about 270km due south of the type locality, but this distribution is congruent with that of other Lepidoptera (Miller & Simon 1998). The species may be expected to be distributed more widely in eastern Cuba and the islands that are part of the Great Bahama Bank. Another species, *Cautethia exuma* McCabe (Sphingidae), was described from the same locality and is apparently endemic to Great Exuma (McCabe 1984).

The flora of the type locality is a mix of native and naturalized species (T. McCabe pers. comm. 2007): *Caesalpinia* L., *Casuarina* L., coconut, *Coccoloba* L., *Erithalis* G. Forst., *Ficus* L., frangipani (*Plumeria rubra* L.), Key Lime, *Malpighia* L., *Mimosa* L., orange, and "old woman's tongue," a legume. The Cuban locality is mixed forest: mostly secondary growth with native dry-forest undergrowth and relictual vegetation in the vicinity characteristic of mogotes; dominant trees include *Acacia* Mill., *Caesalpina*, *Coccoloba*, coconut, *Ficus*, *Gymnanthes lucida* Sw., *Hibiscus elatus* Sw., *Mimosa*, *Plumeria* L., and *Trichilia* L. (J.-P. Rudloff pers. comm. 2008). If the larva is frugivorous on a host common to these areas, *Coccoloba*, *Ficus*, or the legumes are candidates.

The vicariant biogeographic relationship between *Suinoorda* and the rest of the sepiform clade, which is distributed from tropical West Africa to Fiji, parallels other relationships in the cladogram (Fig. 7). *Cliniodes* (node 53) is derived with respect to Asian and African genera. *Dicepolia* (node 67), with both Neotropical and Malagasy species, is related to genera and species distributed around the Indian Ocean. The placement of Malagasy *D. munroealis* is a sampling artifact; additional evidence (Hayden 2009) indicates that the Malagasy

and Neotropical members constitute two monophyletic clades. *Argyrracha margarita*, related to the strictly Neotropical *Mecynarcha* and *Sobanga*, is recorded from Brazil and Madagascar (Munroe 1974a), and *Aeglotis* is Central Asian. Vicariant relationships between Neotropical and Palaeotropical taxa occur in many Lepidoptera (Holloway & Nielsen 1999), although such relationships involving Antillean endemics are better known for other insect orders (Liebherr 1988).

The discovery of congeneric species in the Greater Antilles is probable. Evidence from paleogeography and lepidopteran biogeography suggests that Hispaniola and Puerto Rico are most closely related to the eastern Cuban landmass (Iturrealde-Vinent & MacPhee 1999; Liebherr 1988; Fontenla 2003), and the continued discovery of even conspicuous moth taxa in Hispaniola indicates that the fauna remains poorly known (Rawlins & Miller 2008).

The phylogeny includes about half of the genera in the Eurrhypini (Nuss *et al.* 2008), and it will be tested by an analysis with more taxa and characters (Hayden in prep.). It would be premature to confer a formal name and rank on the sepiform clade, as such an act would relegate the rest of the Eurrhypini to a paraphyletic nominotypical taxon.

There is terminological uncertainty about the squamiform structures. Nuss & Kallies (2001) distinguished two different structures: a plume of long scales in medial position on the vinculum (not shown here) and a pair of "rifled membranes" lateral of the plume. They interpreted the scale plume to be the "structures squamiformes" (Minet 1980; Leraut & Luquet 1983), and they considered the membranes to be a third eurrhypine synapomorphy. The "squamiform structures" of Minet (1980: Figs. 5, 9) probably instead refer to the membranes (M. Nuss pers. comm. 2009). The illustrations of Leraut & Luquet could refer to either structure (1983: Figs. 13, 19), and Munroe neither illustrated nor elaborated on his reference to "specialized scalelike sclerotizations associated with the juxta and vinculum midventrally" (1972: 137). Regardless of terminology, the long plume and the large membranes frequently occur together, although the plume was not observed in dissections of *Suinoorda*. The plume is deciduous, whereas the membranes are less easily removed. One hypothesis is that the membranes and plume are developmental homologs: the vinculum fundamentally bears scales in a transverse row, of which two scales are hypertrophic. The ripples or striations are the longitudinal ridges, which bend laterally so that the lamelliform structures rub across the ridges.

Autocharis was reinstated by Amsel (1970) and

received numerous species removed from *Noorda* Walker (Viette 1990; Shaffer & Munroe 2007). The results indicate that the small, white-and-violet species and the gray species form one monophyletic group. In addition to the genitalia and apomorphies of node 50, *Antocharis* species can be distinguished from *Pseudonoorda* by having long male antennal sensilla and plesiomorphic forewing venation. *D. munroealis* and related species will have been transferred in another publication (Hayden 2009).

Suinoorda maccabei requires a new genus because it cannot be accommodated by any available genus without substantial recircumscription. The next best alternative would be to transfer the whole sepiform clade to the oldest available name, *Clipeosoma* Snellen, 1880. Such an act would stabilize nomenclature by mitigating the proliferation of genera with one or few species, which is a problem in the Odontiinae (Nuss *et al.* 2008). However, synonymy would disrupt several established combinations, including the pest species in *Deanolis* Snellen (Waterhouse 1998).

An important consideration for generic circumscription is the generic diagnosis or definition, which affects the management of specimens identified only to that rank. Historically, most of the genera included in this study were created to accommodate species that did not fit any pre-existing generic diagnosis. The problem lies not with the general practice of fitting species into generic definitions but rather with two specific issues. First, most of the definitions predate Munroe's circumscription of the Odontiinae (1961), so genera were differentiated from distantly related taxa by means of inappropriate characters. Second, the diagnoses are typological, therefore untestable and arbitrarily exact—that is, new monotypic genera were defined with any number of specious characters (*e.g.* Munroe 1974a). Cladistic parsimony equates diagnoses with synapomorphies, making diagnoses both testable and efficient (Farris 1979). Past nomenclatural debates (*e.g.* Ehrlich & Murphy 1982 *et seqq.*) could have benefited from consideration of diagnoses. In the case of *Clipeosoma*, none of the synapomorphies of node 64 are found in previous definitions (Snellen 1880; Hampson 1897). The characters that figure in Snellen's original diagnosis, revived by Munroe (1974b), are either invariant in the Eurrhypini or dispersed across the cladogram (chars. 2, 7, 10, 11, 12). Of these, the pearly, metallic scales on the body and wings (7:2) are shared among the Malagasy and New Guinean species. With the transfer of the Malagasy species, *Clipeosoma* is delimited at node 60 with the following diagnosis: the forewing medial area is concolorous with postmedial/terminal

area (4:2, except *C. orientale*, which has an irregularly darker medial area), the underside of the body and the wings have pearly, metallic scales (7:2), and the costa of the genitalic valva is apically produced in a straight point (32:1).

One might criticize the proposal of a genus for a single species. As suggested above, congeners probably exist in related areas of endemism. More saliently, *Suinoorda* is the first odontiine genus proposed on explicit phylogenetic grounds, and other monotypic genera (*Basonga*, *Metrea*) are synonymized on the same grounds. *Suinoorda* should accommodate any species that share its derived characters: the sexually dimorphic wing pattern (4:1,2), the absence of the forewing antemedial line (8:0), and the gnathos arms near the base of the uncus (36:1).

Pseudonoorda is recovered as paraphyletic, but nomenclatural changes would require study of more species, including the type species *P. minor* Munroe. Munroe (1974b) recognized these two groups of *Pseudonoorda*: one centering on *P. distigmalis* (Hampson) and *P. nigropunctalis* (Hampson), and another on *P. brunneiflava*. The latter group includes at least *P. brunneiflava*, *P. metalloma* (Lower), *P. photina* (Tams) and an undescribed species mentioned by Munroe (1974b). The male of the coded terminal may be Munroe's undescribed species. *Deanolis sublimbalis* Snellen, the red-banded mango borer of Southeast Asia and New Guinea (confused in Munroe 1974b with the spilomeline *Decelia terrosalis* Snellen), is closely related to *Pseudonoorda* species of the first group.

Cliniodes is restricted to South America and the West Indies, except the eastern Nearctic *C. ostreonalis* (see Hayden 2008). *Cliniodes* is diagnosed here by three apomorphies: loss of the androconium from the base of the valval costa (28:0), proximity of the gnathos arms to the uncus (36:1), and a cervix bursae with pleated sclerotization (46:1). Furthermore, *C. ostreonalis* (= *Metrea*) and *C. paradisalis* (= *Basonga*) share with derived *Cliniodes* species the loss of yellow forewing scales and a juxta with a recurved, apical hook. Male genitalia (not figured) indicate that *C. ostreonalis* is closely related to the Andean *C. glaucescens* (Hampson) and two other species, whereas *C. paradisalis* is related to *C. opalis* Guenée and *C. euphrinalis* Möschler.

Epipagis ocellata and *Mecyna catalalis* are misplaced in their respective genera, which both belong in the Spilomelinae. Described in *Sameodes* Snellen, *E. ocellata* is related to the other African species *Epipagis flavispla* (Hampson), *Hapalia iospora* (Meyrick), both of which are here transferred to Eurrhypini, and possibly some of the species placed in *Epascestria* by Maes (2002). Viette (1990: 90) published the

combination “*A[utocharis] catalalis* (Viette), 1953,” but it is not explicit whether the transfer was for *Mecyna catalalis* Viette, 1953a: 136 or for *Dichocrocis catalalis* Viette, 1953b: 208. Regardless, the species would be misplaced in *Autocharis*, so it will be transferred in a future work.

The specific epithets combined with *Tegostoma* and *Clupeosoma* terminate with *-ale* (ICZN 1999: Artt. 31.2, 34.2) because these generic epithets are unambiguously neuter. The original spellings are with *-alis*, as was Zeller’s combination *T. comparalis* (1847: 581). The Greek neuter ending *-ma*, *-mat-* is a common suffix, as in somatic, stomatic. Indeed, the meanings of “*Tegostoma*” and “*Clupeosoma*” evidently refer to character states 3:1 and 7:2, although that fact does not rationalize the present choice of diagnosis. The problems associated with gender agreement (Sommerer 2002) are acknowledged but beyond the scope of this paper.

Predicting missing data is a strong empirical rationale for phylogenetic classification. Given some characters, one can infer the states of other characters to an arbitrary degree of precision. Subsequent observations confirm predictions, thereby expediting field- and labwork. For u unscored cells in characters with n states, there are n^u possible permutations, requiring zero to many extra steps. These predictions follow explicit rules (Fitch 1971) and are replicable.

The results indicate that *Suinoorda* larvae feed on seeds or fruits. One extra step is required if the larvae feed on something else, but without more information about ecology and biology, there is no indication what else that would be. It is possible that the feeding habit is a fifth unobserved state, such as specialization on another tissue or family, though allowing for an unknown state requires process assumptions about character evolution or evolutionary rates.

Most of the predictions herein are precise (Table 3). The least certain area involves the eight species, unscored for feeding habit, above node 42 and below node 54. Those above node 54 are all known or predicted to be external folivores on Thymelaeaceae, which their large body size and aposematism corroborate. Taken individually, the other eight species could assume any of the three habits other than stem-boring/leaf-mining. However, only 17 of the 3^8 possible permutations add no extra steps. For example, *Mecyna catalalis* would feed on Thymelaeaceae only if (1) all the others do the same or if (2) *P. hermesalis*, *V. bethalis* (Viette), and *E. ocellata* do the same and all the others are seed/fruit feeders. The same situation obtains for *E. ocellata* with regard to generalist folivory (state 3). Although there is one tree with substantial support,

ambiguous character mapping clearly complicates phylogenetic predictivity.

Fieldwork will be necessary to observe the feeding habits of *Suinoorda* and any broader distribution or undiscovered congeners; the conclusions above are intended to facilitate that research. The phylogenetic results and generic diagnoses will likewise require testing with more evidence. This analysis demonstrates that the new species is more closely related to Palaeotropical genera than to the known Neotropical ones. The Eurrhypini includes many other genera, and the present sample focuses on the sepiform clade and the superficially similar Neotropical species. Elucidating the relationships of the other major groups will depend on description of novel characters and reexamination of traditional ones.

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LITERATURE CITED

AMSEL, H.G. 1949. Die Microlepidopteren der Brandt'schen Iran-Ausbeute. 1. Teil. Bull. Soc. Fouad Ier d'Entom. (Cairo) 33: 227–269.

—. 1970. Afghanische Pyraustinae. Beitr. naturk. Forsch. SüdwDtl. 29(1): 25–66.

BEESON, C.F.C. 1961. The Ecology and Control of the Forest Insects of India and the Neighboring Countries, 2nd ed. DEhra Dun.

BREMER, K. 1988. The limits of amino acid sequence data in Angiosperm phylogenetic reconstruction. Evolution 42(4): 795–803.

BROWNE, F.G. 1968. Pests and Diseases of Forest Plantation Trees: an annotated list of the principal species occurring in the British Commonwealth. Oxford: Clarendon. p. 475.

CHRISTOPH, H.T. 1887. Lepidoptera aus dem Achal-Tekke-Gebiete. Dritter Theil. Pp. 50–125. In Romanoff, N. M. (ed.). Mémoires sur les Lépidoptères 3. St. Petersburg.

DE OLIVEIRA, M.A. 1942 [1941]. Contribuição ao estudo das pragas e moléstias da Oiticica. Bol. Inspect. Fed. de Obras contra as Sêcas. 16(1) (Jul–Setem.): 19–47.

DENIS, J.N.C.M. & I. SCHIFFERMÜLLER. 1775. Ankündigung eines systematischen Werkes von den Schmetterlingen der Wienergegend herausgegeben von einigen Lehrern am k.k.

Thercsonianum. Augustin Bernardi, Wien. 1–323.

EHRЛИCH, P.R. & D.D. MURPHY. 1982 [1981]. Butterfly nomenclature: a critique. *J. Res. Lepid.* 20(1): 1–11.

EVANS, F.J. (ed.) 1986. Naturally Occurring Phorbol Esters. Boca Raton: CRC Press.

FARRIS, J.S. 1979. The Information Content of the Phylogenetic System. *Syst. Zool.* 28(4): 483–519.

FITCH, W.M. 1971. Toward defining the course of evolution: minimum change for a specific tree topology. *Syst. Zool.* 20(4): 406–416.

FONTENLA, J.L. 2003. Biogeography of Antillean butterflies (Lepidoptera: Rhopalocera): patterns of association among areas of endemism. *Trans. Amer. Entom. Soc.* 129(3+4): 399–410.

GERLACH, J. AND P. MATYOT. 2006. Lepidoptera of the Seychelles Islands. Leiden: Backhuys.

GEYER, C. In Hübner, J. 1826–1832 [1832]. *Zutrage zur Sammlung exotischer Schmettlinge, bestehend in Bekündigung einzelner Flicgmuster neuer oder rarer nichteuropäischer Gattungen.* Augsburg, [1]–[3]–4–6–[7]–8–48, pl. [104]–[137].

GOLOBOFF, P., J. FARRIS, & K. NIXON. 2003. T.N.T.: Tree Analysis Using New Technology, v. 1.1 for Windows. Program and documentation available from the authors and at www.zmuc.dk/public/phylogeny/TNT/. Accessed 14 June 2009.

—, —, AND —. 2008. TNT, a free program for phylogenetic analysis. *Cladistics* 24(5): 774–786.

GROTE, A.R. 1881. New moths from Arizona, with remarks on *Catocala* and *Heliothis*. *Papilio* 1: 153–168.

—. 1882. On Certain Pyralidae. *Papilio* 2: 72–74.

GUENÉE, M.A. 1854. Deltoides et Pyralites. Pp. 1–448. In Boisduval, J. & M.A. Guenée (eds.) *Histoire Naturelle des Insectes. Species Général des Lépidoptères* 8. Paris: Roret.

GWINNE, D.L. & EDWARDS, E.D. 1986. Ultrasound production by genital stridulation in *Syntonarcha iriastis* (Lepidoptera: Pyralidae): long-distance signalling by male moths? *Zool. J. Linn. Soc.* 88: 363–376.

HAMPSON, G.F. 1896. The Fauna of British India, including Ceylon and Burma, London 4 (Moths). pp. i–xxviii, 1–594.

—. 1897. On the classification of two subfamilies of moths of the family Pyralidae: The Hydrocampinae and Scopariinae. *Trans. Entom. Soc. London*: 127–240.

—. 1899a. A revision of the moths of the subfamily Pyraustinae and family Pyralidae. Part I. *Proc. Zool. Soc. London* (1898) (4): 590–761.

—. 1899b. A revision of the moths of the subfamily Pyraustinae and family Pyralidae. Part II. *Proc. Zool. Soc. London* 1899 (1): 172–291.

—. 1901. The Lepidoptera-Phalaenae of the Bahamas. *Ann. Mag. Nat. Hist. (ser. 7)* 7(39): 246–261.

—. 1904. The Lepidoptera-Phalaenae of the Bahamas [continued]. *Ann. Mag. Nat. Hist. (ser. 7)* 14(81): 165–188.

—. 1913a. Descriptions of new species of Pyralidae of the subfamily Pyraustinae. *Ann. Mag. Nat. Hist. (ser. 8)* 11: 322–342, 509–530.

—. 1913b. Descriptions of new species of Pyralidae of the subfamily Pyraustinae. *Ann. Mag. Nat. Hist. (ser. 8)* 12: 1–38, 299–319.

—. 1916. Descriptions of new Pyralidae of the subfamilies Epipaschinae, Chrysinae, Endotrichinae, and Pyralinae. *Ann. Mag. Nat. Hist. (ser. 8)* 18: 126–160, 349–373.

—. In Poulton, E.B. 1916. On a collection of moths made in Somaliland by Mr. W. Feather. *Proc. Zool. Soc. London*: 91–182.

—. 1917. Descriptions of new Pyralidae of the subfamilies Hydrocampinae, Scopariinae, &c. *Ann. Mag. Nat. Hist. (ser. 8)* 20: 201–216, 265–282.

HAYDEN, J.E. 2008. Notes on *Metrea ostronalis* Grote. *News Lepid. Soc.* 50(1): 20–21, 25.

—. 2009. Taxonomic revision of Neotropical *Dicepolia* Snelen (Lepidoptera: Crambidae). *Zootaxa* 2237:1–33, pl. 1–6.

HEINRICH, C. 1921. Some Lepidoptera likely to be confused with the pink bollworm. *J. Agric. Research* 20: 807–836.

HOLLOWAY, J.D. & E.S. NIELSEN. 1999. Biogeography of the Lepidoptera. Ch. 21 in *Handbook of Zoology, Vol. IV Arthropoda: Insecta. Part 36 (Lepidoptera, Moths and Butterflies), Vol. 1 (Evolution, Systematics, and Biogeography)*. N.P. Kristensen, ed. New York: Walter de Gruyter.

HÜBNER, J. 1796–1833 [1796]. *Sammlung europäischer Schmetterlinge.* 6. Horde. Die Zünsler; nach der Natur geordnet, beschrieben und vorgestellt. Augsburg: by the author. [i]–[iv], [i–ii], [i–ii], 1–30, [i–ii], [i–ii], pls. 1–32.

—. 1825 [1816]. *Verzeichniß bekannter Schmettlinge.* Augsburg: by the author. [1]–[3]–4–6–[7]–8–431.

HUERTAS DIONISIO, M. 2007. *Estados inmaduros de Lepidoptera (XXVIII). Cuatro especies de la subfamilia Odontinae Guenée, 1854 en Huelva, España (Lepidoptera: Crambidae).* SHILAP Revta. Lepid. 35 (137): 49–65.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE. 1999. *International Code of Zoological Nomenclature*, fourth ed. London: The International Trust for Zoological Nomenclature.

ITURRALDE-VINENT, M.A. & R.D.E. MACPHEE. 1999. Paleogeography of the Caribbean Region: implications for Cenozoic biogeography. *Bull. Amer. Mus. Nat. Hist.* 238: 1–95.

JANZEN, D.H. & HALLIWACHS, W. 2005. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Área de Conservación Guanacaste (ACG), northwestern Costa Rica. <http://janzen.sas.upenn.edu>, accessed 1 Nov. 2006.

KLIMA, A. 1939. Pyralidae: Subfam.: Pyraustinae II. Pp. 225–383 in: Bryk, F., *Lepidopterorum Catalogus* 94. 's Gravenhage: W. Junk.

KLOTS, A.B. 1956. Lepidoptera. Ch. 20 in *Taxonomist's glossary of genitalia in insects.* S. L. Tuxen, ed. Copenhagen: Ejnar Munksgaard. pp. 97–111.

KORNERUP, A. AND WANSCHER, J.H. METHUEN. *Handbook of Colour.* 2nd ed. London: Methuen & Co. Ltd., 1967.

KRISTENSEN, N.P. 2004. Skeleton and muscles: adults. Ch. 4 in *Handbook of Zoology, Vol. IV Arthropoda: Insecta. Part 36 (Lepidoptera, Moths and Butterflies), Vol. 2 (Morphology, Physiology, and Development)*. N.P. Kristensen, ed. New York: Walter de Gruyter.

LANDRY, B. 1995. A phylogenetic analysis of the major lineages of the Crambinae and of the genera of Crambini of North America (Lepidoptera: Pyralidae). *Memoirs on Entom. Internat.*: 1.

LEDERER, J. 1863. Beitrag zur Kenntniss der Pyralidinen. *Wiener Entom. Monatschrift* 7 (8, 10–12): 243–280, 331–504.

LEECH, H.B. 1949. The occurrence of a hollyhock-seed eater, *Noctuelia rufofascialis*, at Vernon, British Columbia (Lepidoptera: Pyralidae). *Entom. Soc. Brit. Columbia Proc.* 45 (1948): 25.

LEGRAND, H. 1966. Lépidoptères des îles Seychelles et d'Aldabra. – *Mém. Mus. Hist. naturelle (sér. A Zool.)* 37: 1–210.

LEPTREE TEAM. 2008. LepGlossary: Leptree.net. Accessed Oct 03, 2008 at <http://www.leptree.net/g2>.

LERAUT, P. J. A. & LUQUET, G.C. 1983. Statut de quelques genres et espèces d'Odontinae paléarctiques et description de quatre nouveaux taxa (Le. Crambidae). *Linneana Belgica* 8 (1982) (12): 527–555.

LIEBHERR, J.K. 1988. General patterns in West Indian insects, and graphical biogeographic analysis of some circum-Caribbean *Platynus* beetles (Carabidae). *Syst. Zool.* 37(4): 385–409.

LOWER, O.B. 1903. Descriptions of new Australian Noctuina,

&c. Trans. R. Soc. S. Austr. 27: 27–74.

MAES, K.V.N. 1995. A comparative morphological study of the adult Crambidae (Lepidoptera: Pyraloidea). Bull. Ann. Soc. R. Belge Ent. 131:383–434.

—. 2002. Crambidae. Pp. 96–105. In Vári, L., D.M. Kroon & M. Krüger. Classification and Checklist of the species of Lepidoptera recorded from Southern Africa. Chatswood, Australia: Simple Solutions.

MAISTRELLA, L., M.A. LÓPEZ, F.J. SORIA AND R. OCETE. 2005. Growth inhibitory activity of *Daphne gnidium* L. (Thymelaeaceae) extracts on the elm leaf beetle (Col., Chrysomelidae). J. Appl. Entom. 129(8):418–424.

MANN, J. 1969. Cactus-feeding insects and mites. Bull. U.S.N.M. 256.

MARION, H. & P. VIETTE. 1956. Pyrales de Madagascar nouvelles ou peu connues (Lepidoptera). Mém. Inst. Sci. Madagascar, Sér. Entom. (E) 7: 77–115, pl. 1.

MCCABE, T.L. 1984. A new *Cautethia* from the Bahamas (Lepidoptera: Sphingidae). Proc. Entom. Soc. Washington 86(3): 614–618.

MCDUNNOUGH, J. 1931. Note on the larvae of *Metrea ostreonalis* (Pyraustinae, Lepid.). Canad. Entom. 63: 50.

MILLER, J.Y. AND L.D. MILLER. 2001. The biogeography of the West Indian butterflies (Lepidoptera): an application of a vicariance/dispersalist model. pp. 127–155 in Biogeography of the West Indies: Patterns and Perspectives. 2nd ed. C.A. Woods and F.E. Sergile, eds. CRC Press.

MILLER, L.D. AND M.J. SIMON. 1998. Rediscovery of the rare, “endemic” Cuban butterfly, *Achyloides munroei* Bell, with notes on its behavior and possible origin. Caribbean J. Sci. 34: 327–329.

MINET, J. 1980. Création d’une sous-famille particulière pour Noorda Walker, 1859, et définition d’un nouveau genre parmi les Odontinae. Bull. Soc. ent. France 85: 79–87.

MOORE, F. 1884–1887 [1885]. The Lepidoptera of Ceylon. London: L. Reeve. i–xvi, 1–578.

MOORE, F. 1888. Heterocera (continued) (Pyralidae, Crambidae, etc.). Pp. 199–299. In Hewitson, W.C. & Moore, F. Descriptions of new Indian lepidopterous Insects from the collection of the late Mr. W.S. Atkinson 3. London: Taylor & Francis.

MÖSCHLER, H.B. 1886. Beiträge zur Schmetterlings-Fauna von Jamaika. Abhandl. Senck. Naturforsch. Ges. (Frankfurt a. M.) 14: 25–84.

MUNROE, E.G. 1961. Synopsis of the North American Odontinae, with Descriptions of New Genera and Species (Lepidoptera: Pyralidae). Memoirs of the Entomological Society of Canada, Ottawa 24: 1–93.

—. In Dominick, R.B., et al. 1972. The Moths of America North of Mexico, fasc. 13.1B, Pyraloidca (in part). London: E.W. Classey, ltd.

—. 1974a. New genera, species and generic transfers of Neotropical Odontinae (Lepidoptera: Pyralidae). Canad. Entom. 106: 127–137.

—. 1974b. Pyralidae of the third Archbold Expedition. 1. Subfamily Odontinae (Lepidoptera). Tijds. voor Entom. 117(2): 27–37.

—. 1977. Synopsis of *Heortia* Lederer, with descriptions of a new species and a new subspecies (Lepidoptera: Pyralidae: Odontinae). Canad. Entom. 109: 429–441.

—. 1995. Odontinae. Pp. 51–52 in Heppner, J.B. (ed.) Checklist: Atlas of Neotropical Lepidoptera. Gainesville: Assoc. for Neotropical Lepidoptera.

NIXON, K.C. 1999–2002. WinClada ver. 1.00.08. Published by the author, Ithaca, NY, USA. <http://www.cladistics.com/wincDownload.htm> [accessed 2004]

—. & J.M. CARPENTER. 1993. On outgroups. Cladistics 9: 413–426.

—. & J.I. DAVIS. 1991. Polymorphic taxa, missing values and cladistic analysis. Cladistics 7: 233–241.

NUSS, M. & KALLIES, A. 2001. *Titanio caradjae* (Rebel, 1902) comb. n., transferred from Brachodidae (Sesioidca) to Crambidae (Pyraloidea). Nota Lepid. 24 (3): 33–39.

—. and collaborators. 2008. GlobIZ: Globales Informationssystem Zünslerfalter. www.pyraloidca.org, accessed June 2009.

RAWLINS, J.E. & J.S. MILLER. 2008. Dioptine moths of the Caribbean Region: description of two new genera with notes on biology and biogeography (Lepidoptera: Notodontidae: Diptinae). Ann. Carnegie Mus. 76(4): 203–225.

ROBINSON, G.S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. Entom. Gazette 27: 127–132.

—. P.R. ACKERY, I.J. KITCHING, G.W. BECCALONI AND L.M. HERNÁNDEZ. 2001. Hostplants of the moth and butterfly caterpillars of the Oriental Region. London: The Natural History Museum.

—. —. —. —. AND —. 2008. HOSTS: a Database of the World’s Lepidopteran Hostplants. The Natural History Museum (London). www.nhm.ac.uk/research-curation/projects/hostplants/ [accessed 23 Jan. 2008].

ROTHSCHILD, L.W. 1916. Lepidoptera of the British Ornithologists’ Union and Wollaston Expeditions in the Snow Mountains, Southern Dutch New Guinea. Zoological Museum, Tring. 1–148.

SHAFFER, J.C. AND MUNROE, E. 2007 [2003]. Crambidae of Aldabra Atoll (Lepidoptera: Pyraloidea). Trop. Lepid. 14(1–2): 1–110.

SINGH, S., N.D. BARTHIKUR, AND D. GURUNG. 2000. Biogeography of *Heortia vitessoides* Moore (Lepidoptera: Pyralidae: Odontinae [sic]), a major defoliator of *Aquilaaria malaccensis* Lam. (Indian Eagle-wood). Ann. For. 8(1): 109–115.

SLAMKA, F. 2006. Pyraloidea (Lepidoptera) of Europe, Volume 1: Pyralinae, Galleriinae, Epipaschiinae, Cathariinae & Odontinae. Bratislava: by the author.

SMITH, D.S., L.D. MILLER, & J.Y. MILLER. 1994. The Butterflies of the West Indies and South Florida. Oxford U. Press.

SNELLEN, P.C.T. 1880. In Piepers, M.C. & Snellen, P.C.T.: Nieuwe Pyraliden op het Eiland Celebes gevonden. Tijds. Entom. 23 (1879): 198–250.

—. 1892. Bijdrage tot de Kennis der Pyralidina. Tijds. Entom. 35: 152–178.

—. 1899. Nieuwe Aanteekeningen over Pyraliden. Tijds. Entom. 42: 58–95.

SOLIS, M.A. & K.V.N. MAES. 2002. Preliminary phylogenetic analysis of the subfamilies of Crambidae (Pyraloidea Lepidoptera). Belgian J. Entom. 4: 53–95.

SOMMERER, M. 2002. To agree or not to agree—the question of gender agreement in the International Code of Zoological Nomenclature. Nota Lepid. 25(2/3): 191–204.

STEPHENS, J.F. 1834. Illustrations of British Entomology; or, a synopsis of indigenous insects. London: Baldwin and Cradock. 1–433.

SUTRISNO, H. 2002. Cladistic analysis of the Australian *Glyphodes* Guenée and allied genera (Lepidoptera: Crambidae; Spilomelinae). Entom. Science 5(4): 457–467.

SWINHOE, C. 1887. On the Lepidoptera of Mhow, in Central India. Proc. Zool. Soc. London 1886: 421–465.

—. 1894. New species of Geometers and Pyrales from the Khasia Hills. Ann. Mag. Nat. Hist. (6) 14: 135–149.

SWOFFORD, D.L. & W.P. MADDISON. 1987. Reconstructing ancestral character states under Wagner Parsimony. Math. Biosci. 87: 199–229.

TOMINAGA, S. 1999. Hostplants of five species of Pyralidae in Okinawa. Yugato 156 (20 Apr.): 61–62.

TURNER, A.J. 1908. New Australian Lepidoptera of the families Noctuidae and Pyralidae. Trans. & Proc. of the Roy. Soc. of South Austr. 32 (Dec.): 102.

VIETTE, P. 1953 a. Nouvelles Pyrales de Madagascar. Rev.

franç. Entom. 20(1): 130–137.

—. 1953 b. Descriptions de nouvelles espèces de pyrales de la faune Malgache (Ins. Lépid.) Bull. Mens. Soc. Linn. de Lyon 22(8): 203–209.

—. 1954 [1953]. Nouvelles descriptions de Pyrales malgaches (Lépid. Pyraustidae). Bull. Mus. Nat. Hist. Naturelle (2) 25 (Octobre): 483–488.

—. 1958. Pyrales de la region Malgache nouvelles ou peu communes (Lepidoptera). Mém. Inst. Sci. Madagascar (Sér. Entom.) 9: 119–156.

—. 1960. Pyrales nouvelles ou peu connues de Madagascar et des Comores (Lep.). Ann. Soc. Entom. France 129: 151–177.

—. 1990. Crambidae (pp. 84–103) in Faune de Madagascar, supplément 1: A provisional check-list of the Lepidoptera Heterocera of Madagascar. Published by the author.

WALKER, F. 1859. Pyralides. List of the Specimens of Lepidopterous Insects in the Collection of the British Museum 18: 509–798.

—. 1862. Characters of undescribed Lepidoptera in the Collection of W. W. Saunders, Esq. Trans. Entom. Soc. London (3) 1: 70–128.

—. 1866 [1865]. Suppl. 4. List of the Specimens of Lepidopterous Insects in the Collection of the British Museum 34: 1121–1533.

WARREN, W. 1889. On the Pyralidina collected in 1874 and 1875 by Dr. J.W.H. Trail in the basin of the Amazons. Trans. Entom. Soc. London 1889: 227–295.

—. 1890. Descriptions of some new genera of Pyralidae. Ann. Mag. Nat. Hist. (6) 6: 474–479.

—. 1892. Descriptions of new genera and species of Pyralidae contained in the British Museum collection. Ann. Mag. Nat. Hist. (6) 9: 172–179, 294–302, 389–397, 429–442.

WATERHOUSE, D.F. 1998. Ch. 4.6 in ACIAR Monograph No. 51: Biological Control of Insect Pests: Southeast Asian Prospects. Canberra: ACIAR, pp. 105–112.

WILKINSON, M. 1995. Coping with abundant missing entries in phylogenetic inference using parsimony. Syst. Biol. 44(4): 501–514.

ZELLER, P.C. 1847. Bemerkungen über die auf einer Reise nach Italien und Sizilien beobachteten Schmetterlingsarten. Isis von Oken (Leipzig) 8: 561–594.

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Please see Appendices on next 4 pages

Appendix A: Characters.

Head

0. Antennal sensilla: sensilla short in both sexes = 0; male antenna thicker = 1; male sensilla longer = 2; sensilla long in both sexes = 3.

1. Labial palpi, aspect: porrect = 0; upturned = 1. Difficult to discern for species with very short palpi, such as *C. ostreonalis*.

2. Labial palpi, length: shorter than or equal to head = 0; longer than length of head = 1.

3. Frontoclypeal margin: straight = 0; prong = 1; ^-shaped arch = 2 (figs 5, 6: Fc). Despite its exaggeration, the nearly circular structure in *Sninoorda* is homologized with the sharply angled shape in other taxa. At the other extreme, some species have a slightly bowed arch. The double prong, two horizontal projections above the haustellum shared by *Eurrhypis* and *Tegostoma*, is common in many Odontiini.

Wings

4. Forewing medial area, color: terminal and medial areas translucent or paler than postmedial line = 0; terminal area dark, medial area pearly white or yellow = 1 (figs 1, 3, 4); terminal and medial areas dark = 2 (fig. 2); terminal area lighter than medial area = 3. In practice, states 0 and 2 may be hard to discern, e.g. comparing *Dicepolia* to *Hemiscopis* and *Hydrorybina*. In state 0, the red or violet terminal forewing band is fundamentally absent, and any coloration affects the whole forewing de novo. In state 2, the terminal band is fundamentally present, and the medial area is suffused with the same coloration. State 1 broadly characterizes the sharply different coloration between medial and postmedial areas, seen in the white/red pattern of *Sninoorda*, *Autocharis*, etc., the *Schinia*-like pattern of *Mimoschinia*, and the modified aposematic pattern of *Heortia*.

5. Forewing medial area suffusion: absent = 0; with yellow or orange scales = 1. The yellow scales may be diffusely dispersed among whiter scales (*E. ocellata*), or may occupy the entire wing. In some cases (*Heortia*), the pattern is implicated in aposematic mimicry.

6. Extension of forewing costa: absent = 0; costa approximating or fused to postmedial line through discal spot = 1. Applicable only for char. 4 state 1.

7. Sheen of wings and body scales: matte = 0; opalescent, silky, or hyaline = 1; metallic = 2. The difference between states 0 and 1 can best be distinguished on the hindwings. State 2 is restricted to the legs, lower thorax and underside of the wings in *C. orientalale* and *C. vohilavale*, whereas in other species *C. atristriatum* and *C. sericiale*, it also occurs on the dorsal side of the wings.

8. Antemedial line: absent or reduced = 0; present = 1.

9. Proximity of forewing postmedial line to distal wing margin: narrow (PM line near distal margin) = 0; broad (PM line ca. 3/5 from base of wing) = 1.

10. Forewing fovea: absent = 0; present = 1.

11. Forewing Rs_1 : not stalked with Rs_{2+3} = 0 (fig. 10); stalked with Rs_{2+3} = 1.

12. Hindwing M_2 , M_3 : arising separately from cell = 0; stalked = 1.

13. Color in terminal hindwing anal area: not suffused = 0 (figs 1-4); suffused = 1. Inapplicable where the hindwing lacks any trace of color. The absence or strong reduction of coloration on the anal area, at least indicated by the postmedial line's abrupt cessation or convergence with the margin at A1, is also common in *Glaphyriinae*, *Evergestinae*, *Pyraustinae* s. str. and a few *Spilomelinae*.

14. Hindwing anal margin, emargination: absent = 0; present = 1. The round notch in the basal half of the hindwing anal area appears to articulate with the metathoracic legs.

Tympanal organs

15. Saccus tympani, medial rounding: rounded and deep = 0 (fig. 17: ST); medially oblong = 1. The pair of sacci extend anteriad under S2. The outline of state 0 is like a D, and state 1 is more like a "l" shape.

Male genitalia

16. A8 tergite posterior fringe: not expanded = 0; expanded, square, like whole tergite = 1. All Odontiinae have a distinct fringe of hairs on the posterior edge of T8. The fringe is normally a narrow strip (state 0; fig. 12: F); state 1 describes cases where the scale-bearing field is expanded, up to a length:width ratio of 1:1. *Syntonarcha* also has an expanded fringe (Gwynne & Edwards 1986, fig. 2: "cuticular flap").

17. S8 bilobate: straight or monolobate = 0; weakly bilobate (lobe depth less than width) = 1 (fig. 12); strongly bilobate (lobe depth exceeds width) = 2. The anterior, internally extended lobes of sternite 8 evidently serve as muscle insertion sites for the retraction of the genitalia. In state 2, the medial concavity is deeper than the width of either lobe.

18. S8 posterior median projection: absent = 0 (fig. 12); present = 1. This is in the same plane as the rest of the sclerite (cf. characters 19, 20).

19. S8 posterior median projection, shape: simple, triangular = 0; bilobate or trapezoidal = 1. Inapplicable if char. 18 absent.

20. S8 posterior edge: straight = 0; excavate or concave = 1 (fig. 12); boss or saddle-horn = 2 (fig. 9). In state 2, the medial posterior margin emerges out of the plane of the rest of S8.

APPENDIX A (continued)

21. Lamelliform structures: absent = 0 (fig. 12); present = 1 (fig. 9: Lm).

22. Scpiform structures: absent = 0 (fig. 9); present = 1 (fig. 8: Sep).

23. Piluli of S8 (posterolateral of lamelliform structures): absent = 0; present = 1 (fig. 12: Pi). These sensillae occur posterolaterally of lamelliform structures, closer to the posterior corners of S8. See also Nuss & Kallies 2001: fig. 2.

24. Squamiform structures: absent = 0; present = 1 (figs 8–10). These are the paired “rifled membranes” of Nuss & Kallies (2001: fig. 1).

25. Squamal symmetry: symmetrical = 0 (figs 8–10); asymmetrical = 1. See Gwynne & Edwards 1986 for an asymmetrical example not included in this study.

26. Squamiform structures, distal edge: squarish = 0 (fig. 9); rounded = 1 (figs 8, 10).

27. Squamal enations: absent = 0; present = 1 (fig. 8: En). These fold around the sepiform structures where the latter are present, but the presence of a similar mid-squamal protuberance in *Hemiscopis* warrants coding them as a separate character.

28. Basicostal androconia: absent = 0; medium-length to long scales from field at base of costa = 1 (figs 18 & 19: BA); long scales from discrete field at end of sclerotized costa = 2.

29. Main patch of nondeciduous setae: not differentiated = 0; massive, robust setae = 1. Restricted to *Heortia* and *Cliniodes*. In *C. paradisalis*, this is represented by a single, hook-like, basally directed spine near the apex of the valve. Like other sensilla chaetica, it does not absorb Chlorazol stain.

30. Scoop-shaped scales: absent = 0; present = 1 (fig. 18: ScS). These broad scales have fine, closely spaced ridges, pearly lustre, and are shaped like potato chips. They commonly arise from the dorsal side of the valve and curve over the edge. They are often apparent by their lustre and dense packing on the valval edges of partly exposed genitalia.

31. Vincular androconia: absent = 0; present = 1 (fig. 18: VA). Common to most Pyraloidea, this is the pair of androconia on the pleural portion of the A8-A9 intersegmental membrane. Often called “coremata” (e.g. Sutrisno 2002, char. 30; Landry 1995, “coremata on intersegmental membrane VIII-IX”).

32. Apex of costa: not projecting = 0; straight hook = 1; blunt sigmoid (apex out-turned) = 2 (fig. 19); downcurved hook fused to pleated flap = 3.

33. Juxta apex: not differentiated = 0; recurved hook = 1.

34. Gnathos apex: blunt and linguiform = 0; sharp, acute = 1; hatchet-shaped = 2.

35. Gnathos sides: inverse V = 0; inverse Y, with medial process = 1 (fig. 11); compact base with ventral notch = 2; transverse bar = 3. Some gnathoi coded as state 0, including *S. maccabei*, have bent lateral arms and approximate state 1, but the bends lie well below the medial junction, more like a capital upsilon.

36. Gnathos base-uncus base: gnathos base not articulating with uncus lower corners = 0; gnathos base near or articulating with uncus lower corners = 1 (fig. 11).

37. Phallus: not spiral = 0; spiral = 1.

Female genitalia

38. Ovipositor length: short = 0 (fig. 16); long = 1.

39. Colliculum: short = 1 (fig. 16: C); long (most of length of ductus) = 2.

40. Ductus bursae sclerotization: absent = 0; smooth, extending along the long, narrow ductus bursae = 1; rough, on limited area of cervix bursae = 2. In many Eurrhypini, including *Suinoorda*, the ductus bursae is expanded as a cervix bursae (fig. 16: CvB). In this sample of taxa, no clear distinction could be made between the typically long, narrow ductus and a short, inflated cervix bursae. Species with state 1 have the ductus bursae mostly but weakly sclerotized, whereas state 2 represents a limited area that is often granular. *Suinoorda* and *Noordodes* share a large cervix bursae occupied by massive, irregular sclerotization.

41. Appendix of ductus bursae: absent = 0; present = 1.

42. Corpus bursae signum: absent = 0; present (1 or 2) = 1 (fig. 16).

43. Corpus bursae signum shape: round = 0 (fig. 16); linear = 1. Inapplicable if char. 42 absent.

44. Ductus seminalis origin: from ductus bursae = 0 (fig. 16: DS); from corpus bursae, with signum extension = 1.

45. Ductus seminalis basal width: narrow = 0; enlarged = 1.

46. Pleats or wrinkles on cervix bursae: absent = 0; present = 1; present over both cervix and corpus bursae = 2. State 2 represents cases where there is no clear distinction between the plications of the cervix and corpus bursae. In *Suinoorda*, pleats occur on the corpus, but they are clearly not continuous from the irregularly shaped sclerotization of the cervix.

Larva

47. Feeding habit: tube-dwelling stem borer or leaf miner = 0; seed and fruit pulp feeder = 1; folivore, Thymelaeaceae = 2; folivore, other = 3. The states reflect plausible physiological and metabolic constraints. The external silken tube of Eurrhypis and Tegostoma is probably a modification of an ancestrally internal gallery, retained for feeding on thin-branched hostplants. Thymelaeaceae produce many unique feeding deterrents (Maistrello *et al.* 2005), and folivory on this family is rare in Lepidoptera (Robinson *et al.* 2008). How correctly the states are defined will emerge as new records are obtained (see the predicted values).

APPENDIX B: Data matrix. ?: unobserved, -: inapplicable. More than one state: A: [01], B: [02], C: [12], D: [23]

Terminal	Character Number										
	0	5	10	15	20	25	30	35	40	45	
<i>Cynaeda dentalis</i> -----	2	0	0	0	0	0	0	0	0	0	0
<i>Tegostoma comparale</i> -----	2	0	1	0	0	0	1	0	0	1	0
<i>Aeglotis argentalis</i> -----	D	0	1	0	1	1	0	0	0	1	3
<i>Argyrarcha margarita</i> -----	0	0	0	1	0	1	1	0	0	0	1
<i>Autocharis albiplaga</i> -----	2	0	1	2	1	0	0	1	0	1	0
<i>Autocharis barbieri</i> -----	2	0	1	2	A	0	0	1	1	0	0
<i>Autocharis fessalis</i> -----	2	0	1	2	1	0	0	0	1	2	0
<i>Autocharis mimetica</i> -----	2	0	1	2	1	0	0	0	0	2	0
<i>Cliniodes costimacula</i> -----	0	0	0	2	1	1	0	0	0	1	0
<i>Cliniodes opalalis</i> -----	3	1	0	0	0	1	0	0	2	1	0
<i>Cliniodes ostreonalis</i> -----	1	A	0	0	0	1	1	0	0	1	D
<i>Cliniodes paradisalis</i> -----	1	1	0	1	1	0	0	0	2	1	0
<i>Clupeosoma atristriatum</i> -----	0	0	1	0	2	0	0	1	1	1	0
<i>Clupeosoma orientale</i> -----	0	0	0	3	0	2	0	0	1	0	1
<i>Clupeosoma sericiale</i> -----	0	0	0	2	0	2	0	1	1	0	1
<i>Clupeosoma vohilavale</i> -----	1	0	A	0	2	0	1	0	0	1	A
<i>Deanolis sublimbalis</i> -----	0	0	1	0	1	0	0	1	0	0	1
<i>Dicepolia munroensis</i> -----	?	0	1	2	0	0	0	1	0	1	0
<i>Dicepolia roseobrunne</i> -----	2	0	1	2	0	0	0	1	1	3	0
<i>Dicepolia rufitinctalis</i> -----	0	0	1	2	0	0	0	1	1	3	0
<i>Ephelis cruentalis</i> -----	2	0	0	1	0	0	0	0	1	0	0
<i>Epipagis ocellata</i> -----	1	0	0	1	1	1	0	0	0	1	0
<i>Eurrhypis pollinalis</i> -----	2	0	1	1	1	0	0	0	1	0	0
<i>Hemiscopis suffusalis</i> -----	0	0	1	0	2	0	0	1	0	0	0
<i>Heortia dominalis</i> -----	1	0	1	1	1	1	0	0	1	2	0
<i>Heortia vitessoides</i> -----	1	1	0	1	1	1	0	0	1	2	0
<i>Hyalinarcha hyalinalis</i> -----	2	0	2	0	0	0	0	1	0	0	1
<i>Hydrorybina polusalis</i> -----	0	0	1	0	2	0	1	1	0	0	0
<i>Mecyna catalalis</i> -----	0	0	0	2	1	1	0	0	0	1	0
<i>Mecynarcha apicalis</i> -----	0	0	0	2	0	1	0	0	0	1	0
<i>Mimoschinia rufofascialis</i> -----	2	0	0	1	0	0	0	0	0	1	2
<i>Noordodes magnificalis</i> -----	0	0	2	1	0	0	0	1	0	0	1
<i>Pitama hermesalis</i> -----	1	0	0	1	0	0	0	1	0	0	0
<i>Pseudonocorda brunneiflava</i> -----	0	0	2	A	0	0	1	0	0	1	2
<i>Pseudonocorda distigmalis</i> -----	0	0	1	0	0	1	0	1	1	0	2
<i>Pseudoschinia elautalis</i> -----	2	0	0	1	0	0	0	0	1	1	0
<i>Sobanga rutilalis</i> -----	0	0	0	1	1	0	0	0	0	1	0
<i>Suinoorda maccabei</i> -----	0	0	2	C	0	1	0	0	0	1	2
<i>Viettessa bethalis</i> -----	1	0	1	1	0	1	0	0	1	1	0

APPENDIX C: Unambiguous character state changes of nodes for cladogram (fig. 7). Format: "character: primitive state --> derived state." Obtained with TNT commands "Optimize / Synapomorphies / List synapomorphies."

<i>Cynaeda dentalis</i> :	5: 0 --> 1	31: 1 --> 0	Node 59 :
No autapomorphies	6: 0 --> 1	Node 42 :	10: 0 --> 1
<i>Tegostoma comparale</i> :	13: 0 --> 1	6: 0 --> 1	12: 0 --> 1
3: 0 --> 1	46: 0 --> 1	15: 0 --> 1	16: 0 --> 1
13: 0 --> 1	<i>Hemiscopis suffusalis</i> :	Node 43 :	Node 60 :
38: 0 --> 1	13: 0 --> 1	0: 2 --> 0	4: 1 --> 2
<i>Aeglotis argentalis</i> :	20: 1 --> 2	43: 1 --> 0	7: 1 --> 2
0: 0 --> 23	27: 0 --> 1	Node 44 :	32: 0 --> 1
2: 0 --> 1	<i>Heortia dominalis</i> :	7: 0 --> 1	Node 61 :
<i>Argyrarchia margarita</i> :	2: 0 --> 1	30: 0 --> 1	3: 2 --> 0
20: 1 --> 2	17: 1 --> 0	42: 0 --> 1	18: 0 --> 1
<i>Autocharis albiplaga</i> :	<i>Heortia vitessoides</i> :	Node 45 :	Node 62 :
38: 1 --> 0	1: 0 --> 1	20: 0 --> 1	45: 0 --> 1
39: 2 --> 1	9: 0 --> 1	47: 0 --> 1	Node 63 :
<i>Autocharis barbieri</i> :	46: 0 --> 2	Node 46 :	11: 0 --> 1
No autapomorphies	<i>Hyalinarcha hyalinalis</i> :	17: 0 --> 1	23: 1 --> 0
<i>Autocharis fessalis</i> :	20: 1 --> 2	21: 0 --> 1	38: 0 --> 1
12: 0 --> 1	23: 1 --> 0	23: 0 --> 1	Node 64 :
<i>Autocharis mimetica</i> :	31: 1 --> 0	24: 0 --> 1	21: 1 --> 0
42: 1 --> 0	46: 0 --> 1	Node 47 :	22: 0 --> 1
<i>Cliniodes costimacula</i> :	<i>Hydrorybina polusalis</i> :	16: 0 --> 1	26: 0 --> 1
0: 1 --> 0	11: 0 --> 1	17: 1 --> 0	27: 0 --> 1
<i>Cliniodes opalalis</i> :	17: 1 --> 2	25: 0 --> 1	40: 0 --> 2
0: 1 --> 3	38: 0 --> 1	36: 0 --> 1	Node 65 :
35: 0 --> 2	46: 0 --> 1	Node 48 :	2: 0 --> 1
39: 1 --> 2	<i>Mecyna catalalis</i> :	20: 1 --> 0	14: 0 --> 1
<i>Cliniodes ostreonalis</i> :	5: 0 --> 1	34: 1 --> 2	19: 0 --> 1
4: 12 --> 0	<i>Mecynarcha apicalis</i> :	Node 49 :	34: 1 --> 2
35: 0 --> 3	4: 1 --> 2	35: 1 --> 0	46: 1 --> 0
<i>Cliniodes paradisalis</i> :	13: 0 --> 1	40: 0 --> 2	Node 66 :
31: 1 --> 0	<i>Mimoschinia</i>	Node 50 :	41: 0 --> 1
42: 1 --> 0	<i>rufofascialis</i> :	38: 0 --> 1	Node 67 :
<i>Clupeosoma atristriatum</i> :	38: 0 --> 1	39: 1 --> 2	37: 0 --> 1
2: 0 --> 1	46: 0 --> 2	47: 1 --> 3	43: 1 --> 0
<i>Clupeosoma orientale</i> :	<i>Noordodes magnificalis</i> :	Node 51 :	Node 68 :
4: 2 --> 3	No autapomorphies	2: 0 --> 1	2: 0 --> 1
<i>Clupeosoma sericiale</i> :	<i>Pitama hermesalis</i> :	17: 1 --> 2	9: 0 --> 1
No autapomorphies	6: 1 --> 0	Node 52 :	34: 1 --> 0
<i>Clupeosoma volhilavale</i> :	35: 0 --> 1	32: 0 --> 3	Node 69 :
0: 0 --> 1	<i>Pseudonoorda</i>	35: 0 --> 1	4: 1 --> 2
8: 0 --> 1	<i>brunneiflava</i> :	Node 53 :	18: 0 --> 1
34: 1 --> 0	20: 1 --> 0	28: 1 --> 0	Node 70 :
<i>Deanolis sublimbalis</i> :	26: 1 --> 0	36: 0 --> 1	16: 0 --> 1
No autapomorphies	42: 1 --> 0	46: 0 --> 1	29: 0 --> 1
<i>Diccoplia mnrorealis</i> :	<i>distigmalis</i> :	Node 54 :	Node 71 :
15: 0 --> 1	No autapomorphies	13: 0 --> 1	34: 1 --> 0
17: 2 --> 1	<i>Pseudoschinia elautalis</i> :	34: 1 --> 0	Node 72 :
42: 1 --> 0	No autapomorphies	40: 0 --> 2	40: 0 --> 1
<i>Diccoplia roseobrunnea</i> :	<i>Sobanga rutilalis</i> :	Node 55 :	Node 73 :
20: 1 --> 0	20: 1 --> 0	5: 0 --> 1	8: 1 --> 0
<i>Diccoplia rufitinctalis</i> :	21: 1 --> 0	Node 56 :	9: 0 --> 1
0: 2 --> 0	24: 1 --> 0	0: 0 --> 1	17: 1 --> 2
12: 0 --> 1	<i>Sninoorda maccabei</i> :	Node 57 :	
<i>Ephelis cruentalis</i> :	36: 0 --> 1	15: 1 --> 0	
No autapomorphies	<i>Viettessa bethalis</i> :	28: 0 --> 2	
<i>Epipagis ocellata</i> :	38: 0 --> 1	29: 0 --> 1	
38: 0 --> 1	42: 1 --> 0	34: 0 --> 1	
41: 0 --> 1	Node 41 :	Node 58 :	
<i>Eurhyps pollinalis</i> :	3: 0 --> 1	5: 1 --> 0	
		33: 0 --> 1	

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KY BUTTERFLY NET: AN INTERACTIVE WEB DATABASE TO FACILITATE LEPIDOPTERA
RESEARCH AND EDUCATION IN KENTUCKY

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ABSTRACT. Kentucky Butterfly Net is a World Wide Web database that collects and reports distribution data for the 2,488 species of Lepidoptera (butterflies and moths) known from the state of Kentucky, USA. It includes tools for entering, editing, and curating new records. Species queries in Kentucky Butterfly Net can be initiated using either scientific or common names. Species query reports include range maps and phenology spindle diagrams dynamically generated from the data. Location queries can produce species lists of all Lepidoptera, just butterflies or just moths for 244 geographic localities, corresponding to the 120 counties of Kentucky, plus an additional 124 conservation units. To date, a total of 61,231 records covering the years 1872–present are included in the database. These data represent an important resource for both education and research on the Lepidoptera of Kentucky.

Additional key words: biogeography, climate change, citizen science, web database.

Regional guides to Lepidoptera are an important resource for both professionals and amateurs. They serve a wide variety of purposes as varied as facilitating the identification of crop pests, providing the raw data for the study of biogeography, and satisfying the curiosity of casual inquirers. In the United States important examples of such guides include the 4 volumes of *The Lepidoptera of New York and Neighboring States* (Forbes 1923, 1948, 1954, 1960), *The Lepidoptera of Florida: An Annotated Checklist* (Kimball 1965), and the 3 volumes of *A List of the Lepidoptera of Maine* (Brower 1974, 1983, 1984). For the study of butterflies and moths in Kentucky and adjacent states, Covell (1999) has been an important reference. However, these print guides have limitations. They very quickly go out of date as additional collections and observations are made (Covell & Gibson 2008, Covell *et al.* 2000, Gibson & Covell 2006), as new species are described or species names are revised (Covell *et al.* 2000), and as species distributions change over time (Gibson & Covell 2006). Regional guides can also be difficult to obtain after they go out of print, making it difficult (and sometimes expensive) for those newly interested to access the information that they contain.

To address these issues, a number of World Wide Web-based projects have been initiated (see http://www.lepsoc.org/lepidoptera_websites_databases.php). These include projects that attempt to cover Worldwide (Oehlke 2007, Pittaway & Kitching 2008), North American (Opler *et al.* 2006, Poole 1999), or national (CBIF 2006, Roy 2008), distributions of select species, or more comprehensive treatments of all Lepidopteran species in particular conservation units, such as Great Smoky Mountains National Park, USA (NPS 2007) or Área de Conservación Guanacaste, Costa Rica (Janzen & Hallwachs 2005). Our own project is a World Wide Web-based description of the known lepidopteran fauna on an intermediate geographic scale, the state of Kentucky, USA, which covers approximately 10.5 million square kilometers.

The history of Kentucky Lepidoptera studies and early publications, almost exclusively restricted to Kentucky butterflies, can be found in the “History” section of Covell (1999, pp. 2–6). Beginning in 1964, a file of data on collections and observations of all Kentucky Lepidoptera was begun by Covell from historical and current field collections and reliable observations. To add to the known state fauna, the Society of Kentucky Lepidopterists was formed in 1974,

and members have met in various localities in the state to collect specimens and record observations. Unidentified specimens were taken to various moth specialists, notably at the U. S. National Museum of Natural History (Smithsonian Institution) in Washington, DC. These colleagues identified many moths, some of them found to be new to science, and others found to represent major extensions of known ranges.

The project described here builds upon these earlier efforts to collect, organize, and share Kentucky Lepidoptera records. We have created a world wide web-based version of a Microsoft Access database, complete with tools for distributed data entry, curation, and visualization by species or locality to facilitate research and educational activities concerning the Lepidoptera of this region. This resource is known as Kentucky Butterfly Net and is available at <http://www.kybutterfly.net>.

MATERIALS AND METHODS

Database history and design. Efforts to systematically inventory the Lepidoptera of Kentucky began in 1964 with records entered by hand on large file cards, and filed alphabetically by family, genus, and species. In 1995, data were transferred from these cards to a Microsoft Excel spreadsheet to facilitate the preparation of Covell (1999), *The butterflies and moths (Lepidoptera) of Kentucky: an annotated checklist*, but data continued to be organized alphabetically. In 2002, with the assistance of Rick Ruggles, the data were transferred to Microsoft Access to create a desktop computer-based relational database.

In creating the relational Microsoft Access database, specific requirements were: to reorganize the data to store it efficiently and to facilitate queries; to include all previously recorded data, making concessions for records that are incomplete or vague; to migrate the existing data cost effectively minimizing manual re-entry; to allow queries of the data based on taxonomy, location and date; to allow the entry of new data with additional information such as GPS location; and to provide a mechanism of curation and validation of newly entered data.

As currently construed, Kentucky Butterfly Net is a Microsoft Access relational database installed on a server running Microsoft IIS (Internet Information Services) and ASP (Active Server Pages). Records for species and geographic localities must match entries that appear in the respective lookup tables. The addition of a new species to the Kentucky species list or the addition of a new conservation unit to the locality list

requires correspondence with one of the database curators. For more routine additions to the database, a series of dynamic web pages were created in ASP to permit users from remote locations to query the database or add new records over the web through a browser interface. We chose to utilize a database structure that is non-normalized to accommodate legacy data. New data are validated by automated validation routines as well as by an administrative user to ensure accuracy and completeness. Finally, queries take into account both normalized and non-normalized data to display the resulting dataset accurately.

Data entry and curation. Data entry permission is password protected to prevent hacking and electronic vandalism. People with Lepidoptera records from Kentucky to include in the database should contact one of the authors to receive a username and password. A convenient set of pull-down menus and text boxes allows rapid data entry, and users can correct or delete their own records that contain errors. Once entered, records are placed in an approval queue, but are not part of the searchable database until the records are approved by a database curator with administrative access. Administrative access is also password protected, and currently restricted to the authors of this paper. Database curators can approve records, deny them, or leave them in the queue pending receipt of further information (digital photos, specimens, or other opinions).

Queries by species. Species queries in Kentucky Butterfly Net can be initiated by entering either scientific or common names. Species query reports include range maps and phenology spindle diagrams dynamically generated from the records in the data, a complete list of which is also included in the report (Fig. 1). Also included in each species report are links to digital photos of mounted specimens for each species from the image libraries of the North American Moth Photographers Group (Patterson 2005), Tortriid Net (Gilligan 2008) and Nearctica.com (Poole 1999).

Queries by location. To facilitate the compilation of species lists for particular localities, location queries are available by county or by conservation unit. Locations can be selected by name or by clicking through a map-based interface. Some large conservation units span county boundaries, so records can be called up for portions of the unit or for the unit as a whole. County record lists include records from conservation units within the county. Location queries can produce a list of all Lepidopteran species, just butterfly species, or just moth species recorded from that location, with a link to the species query report for each taxon on the list.

RESULTS

To date, a total of 61,231 records describing 2,488 known species for the state of Kentucky are included in the database. Included among these are the records contained in published species lists for the state of Kentucky (Covell 1999, Covell & Gibson in press., Covell *et al.* 2000, Gibson & Covell 2006), records published in the Season Summaries of the Lepidopterists' Society and in the Newsletter of the Society of Kentucky Lepidopterists, as well as numerous unpublished observations.

The records cover the period of 1872–present, with the majority of records dating from the last 45 years. Each record corresponds to one or more specimens of a single species collected, photographed, or observed together on a single day in one of 244 geographic localities, corresponding to the 120 counties of Kentucky, plus an additional 124 conservation units (National Parks, National Forests, State Parks, Wildlife Management Areas, etc.). For a small minority of recent records, GPS coordinates are also available. Moth records are generally specimen-based. Butterfly records

include a mixture of specimen-based, photograph-based, and observation-based reports. Reports based on photographs or observations are indicated as such.

DISCUSSION

Education and public outreach. On-line databases such as Kentucky Butterfly Net can play an important role in raising public awareness about the Lepidoptera of a particular region. Casual visitors to the web site, especially those from understudied counties within the state, upon finding that many species are missing, frequently begin to document the species found within their area and report them. More formally, the database is used in conjunction with field collections in entomology and biodiversity courses at Western Kentucky University, and K-12 schools are beginning to take advantage of its availability as well. Since it went live in January 2007, over 1900 users have consulted the Kentucky Butterfly Net database.

Invasive Species. Kentucky Butterfly Net and other similar databases are very useful for monitoring invasive species. Information about the detection and spread of

KY Butterfly Net Database

Query Results

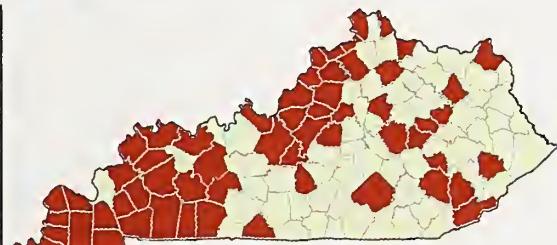
New Query

Family	Nymphalidae
Genus	Limenitis
Species	archippus
Common Name	Viceroy

Spindle Detail

Earliest Sighting: April 27

Latest Sighting: October 10

Image © Robert W. Poole at Nearctica.com

Date of first observation: August 25, 1890

Most recent observation: May 13, 2008

Date	# of Specimens	Location	County	Collected By	Determined By	Notes	GPS N	GPS W
May 13, 2008	1		Menifee	photo	Rita S. Adkins	Joe Harmon Rd., Frenchburg, Ky.		
September 19, 2007	1		Menifee	photo	Rita S. Adkins	On Joe Harmon Rd., about 2.5 miles South of Frenchburg		
September 8, 2007	1	Paducah	McCracken	Loran Gibson	Loran Gibson	Streetman's Property		
August 25, 2007	1		Meade	Loran Gibson	Loran Gibson	Lapland and Vicinity of Battletown		
June 17, 2007	1		McCracken	Loran Gibson	Loran Gibson	Littleville		
May 22, 2007	1		Bracken	Loran Gibson	Loran Gibson	Meldahl Dam		

FIG. 1. Example of a species query report from Kentucky Butterfly Net for the viceroy, *Limenitis archippus* (Cramer, 1776). This species is the state insect of Kentucky. Included in the report is a photo of the species, a dynamically generated range map, a dynamically generated phenology chart (or "spindle diagram"), the dates of the first and most recent observations of the species in the state, and a comprehensive list of records for the species. The list of records has been truncated for inclusion here.

such species needs to be shared quickly and must be accessible to as many interested people as possible, making web-based technologies particularly appropriate. There are a number of non-native Lepidoptera known from Kentucky, some of which, such as the meadow fritillary, *Boloria bellona* (Fabricius), invaded and spread from East to West through the state in less than 25 years, perhaps along the interstate highway system (Covell 1999). Another species, the European skipper *Thymelicus lineola* (Ochsenheimer), was present in the state for decades, becoming locally common in some areas, but did not spread as widely, and may now be extirpated since it has not been recorded from Kentucky since 1989 (Covell 1999). In 2000, Jonathan Smith collected the first Kentucky specimen of a Eurasian noctuid moth, *Noctua pronuba* (Linnaeus), which has been spreading throughout North America since its apparent introduction from Europe in 1979 (Covell & Gibson in press.).

Rare and Threatened Species. Databases such as Kentucky Butterfly Net are also important for monitoring populations of rare or threatened species. The distribution maps included in species reports can be used to illustrate to landowners the rarity of Lepidopteran populations on their properties and may help to enlist their cooperation in protecting those populations. It can also help governmental regulatory agencies and nonprofit conservation groups to identify populations that are in need of protection. Species that may fit these criteria in Kentucky include the Duke's Skipper, *Euphyes dukesii* (Lindsey), the broad-winged skipper, *Poanes viator* (W.H. Edwards), the Olympia marble, *Euchloe olympia* (W. H. Edwards), the Ozark Swallowtail, *Papilio joanae* (J. R. Heitzman), the Northern metalmark, *Calephelis borealis* (Grote & Robinson), the swamp metalmark, *Calephelis mutica* (McAlpine), and the rattlesnake master borer moth, *Papaipeua eryngii* (Bird). It can also help identify outlying populations of species that are geographically and possibly also genetically distinct from the rest of the species distribution. An example may be the population of brown elfin butterflies *Callophrys augustinus* (Kirby) discovered in Mammoth Cave National Park in 2005 by Ian Segebarth during a Lepidoptera inventory, which is over 200 km away from the nearest known neighboring population of that species.

Global Climate Change and Habitat Loss. Lepidoptera are frequently used as indicator species because many species (especially butterflies) are easy to observe and identify and also respond to changes in habitat very quickly. The United Kingdom Butterfly Monitoring Scheme in particular has provided

important insights into the effects of habitat loss and climate change on Lepidopteran populations (Warren *et al.* 2001). Kentucky Butterfly Net reveals several different ways in which Lepidopteran populations respond to climate change.

First, Lepidoptera respond by changing their phenology and emergence times. The Olympia marble butterfly, *Euchloe olympia* has a single brood each year in the early spring, with adults flying for a period of about two weeks, typically centered around 15 April. In late March 2007, presumably in response to unseasonably warm weather (daily highs of 32–35°C), *E. olympia* emerged early in disparate areas of the state, emerging by 24 March in Owsley County and by 2 April in Mammoth Cave National Park, Edmonson County. These are the two earliest emergence times for *E. olympia* on record in Kentucky, and 2–3 weeks earlier than in a typical year. The third earliest Kentucky record for this species is from 7 April 1963 by Jack Dempwolf, from Natural Bridge State Resort Park in Powell County.

Species also respond by shifting their ranges. Kentucky seems to be experiencing an increase in the occurrence of migrants from the South. In 2008, two different individuals photographed a small pink moth, *Pyrausta inornatalis* (Fernald) (Crambidae), known before only from Texas to Tennessee. Southern butterfly species rarely seen in Kentucky have been recorded in recent years more often, and also earlier in the season. These colonize northward into Kentucky, become frequent in late summer, then die back in winter. Species in this category include the long-tailed skipper, *Urbanus proteus* (Linnaeus), and the Gulf Fritillary, *Agraulis vanillae* (Linnaeus). Oldham County, Ky. July 4th butterfly counts, conducted since 1976 around the beginning of July by Covell, reveal that one cloudless sulfur, *Phoebis sennae* (Linnaeus), was seen in 1992—a unique occurrence from 1976 to 2002—while 6–17 individuals were counted in each year, 2004–2007. Similarly, two individuals of the sleepy orange, *Eurema nicippe* (Cramer), were recorded in 1992 as the only occurrences between 1976 and 2000. In 2001, 4 were seen, and 44 have appeared in 2003–2008. The gemmed satyr, *Cyllopsis gemma* (Hübner), was not found at all until 1999 since which a total of 43 have been seen. In like manner, the Carolina Satyr, *Hermeuptychia sosybius* (Fabreius) was first discovered at the study site in 2002, and has since been seen there in 3 of the six subsequent counts (Covell unpublished).

However, when these observations are paired with a third pattern, the apparent disappearance of several "Northern" species that used to be observed in Kentucky, suspected effects of climate change become

even more apparent. Species in this category include the regal fritillary, *Speyeria idalia* (Drury), not seen since 1972, the green comma, *Polygonia faunus* (W. H. Edwards), not seen since 1973, and the gray comma, *Polygonia progne* (Cramer), not reported since 1977. These apparent disappearances have occurred in spite of considerable effort to find these species, so changes in collector effort cannot be used to explain the disappearance of these species.

It is possible that each of these changes is caused by factors other than global climate change, but taken together they indicate the Lepidopteran fauna of Kentucky is clearly changing in a manner consistent with a gradual increase in average annual temperatures.

Future directions. We hope to continue to develop tools to facilitate research and educational activities that take advantage of Kentucky Lepidoptera distribution data. We are particularly looking forward to developing connections between Kentucky Butterfly Net and other projects involving Lepidoptera in Kentucky such as the Upper Green River Barcode of Life Project (Marcus *et al.* 2010, unpub. data). We would also welcome the opportunity to help others develop web database applications for collecting and sharing distribution data for both Lepidoptera and other organisms.

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LITERATURE CITED

BROWER, A. E. 1974. A list of the Lepidoptera of Maine. Part 1: The macrolepidoptera. *Maine Agr. Expt. Stn. Tech. Bull.* 66: 1–136.

_____. 1983. A list of the Lepidoptera of Maine. Part 2: The microlepidoptera, Section 1, Limacodidae through Cossidae. *Maine Agr. Expt. Stn. Tech. Bull.* 109: 1–60.

_____. 1984. A list of the Lepidoptera of Maine. Part 2: The microlepidoptera, Section 2, Cosmopterigidae through Hepialidae. *Maine Agr. Expt. Stn. Tech. Bull.* 114: 1–70.

CBIF. 2006. Butterflies of Canada. http://www.cbif.gc.ca/spp_pages/butterflies/index_e.php.

COVELL, C. V., JR. 1999. The butterflies and moths (Lepidoptera) of Kentucky: an annotated checklist. *Kentucky State Nature Preserves Commission Scientific and Technical Series* 6: 1–220.

COVELL, C. V., JR. & L. D. GIBSON. 2008. More new moth records (Lepidoptera) from Kentucky. *J. Ky. Acad. Sci.* 69: 193–196.

COVELL, C. V., JR., L. D. GIBSON & D. J. WRIGHT. 2000. New state records and new available names for species of Kentucky Moths (Insecta: Lepidoptera). *J. Ky. Acad. Sci.* 61: 105–107.

FORBES, W. T. M. 1923. The Lepidoptera of New York and neighboring states: 1. Primitive forms, Microlepidoptera, Pyraloids, Bombyces. *Memoir 68. Cornell University Agricultural Experiment Station, Ithaca, NY*, 729pp.

_____. 1948. The Lepidoptera of New York and neighboring states: 2. Geometridae, Sphingidae, Notodontidae, Lymantriidae. *Memoir 274. Cornell University Agricultural Experiment Station, Ithaca, NY*, 263pp.

_____. 1954. The Lepidoptera of New York and neighboring states: 3. Noctuidae. *Memoir 329. Cornell University Agricultural Experiment Station, Ithaca, NY*, 433pp.

_____. 1960. The Lepidoptera of New York and neighboring states: 4. Agaristidae through Nymphalidae including butterflies. *Memoir 371. Cornell University Agricultural Experiment Station, Ithaca, NY*, 188pp.

GIBSON, L. D. & C. V. COVELL JR. 2006. New records of butterflies and moths (Lepidoptera) from Kentucky. *J. Ky. Acad. Sci.* 67: 19–21.

GILLIGAN, T. M. 2008. Tortricid Net. <http://www.tortricid.net>. Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO.

JANZEN, D. H. & W. HALLWACHS. 2005. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica <http://janzen.sas.upenn.edu>.

KIMBALL, C. P. 1965. The Lepidoptera of Florida: An annotated checklist. *Division of Plant Industry, State of Florida Department of Agriculture, Gainesville, FL*, 363pp.

MARCUS, J. M., T. M. HUGHES, D. M. McELROY & R. E. WYATT. 2010. Engaging first year undergraduates in hands-on research experiences: The Upper Green River Barcode of Life Project. *J. Coll. Sci. Teach.* 39 (3): 24–30.

NPS. 2007. Discover Life in America (<http://www.dlia.org/>). Great Smoky Mountains National Park, Gatlinburg, TN 37738–3627.

OEHLKE, B. 2007. World's Largest Saturniidae Site. <http://www.silkmoths.bizland.com/indexos.htm>.

OPLER, P. A., H. PAVULAA, R. E. STANFORD & M. POGUE. 2006. Butterflies and Moths of North America. Bozeman, MT: NBII Mountain Prairie Information Node. <http://www.butterfliesandmoths.org/>.

PATTERSON, R. 2005. North American Moth Photographers Group. <http://mothphotographersgroup.msstate.edu>.

PITTAWAY, A. R. & I. J. KITCHING. 2008. Sphingidae of the Eastern Palaearctic. <http://tpittaway.tripod.com/china/china.htm>.

POOLE, R. W. 1999. Nearctica.com: The Natural History of North America. <http://www.nearctica.com/>.

ROY, D. 2008. United Kingdom Butterfly Monitoring Scheme. <http://www.ukbms.org/>.

WARREN, M. S., J. K. HILL, J. A. THOMAS, J. ASHER, F. R., B. HUNTER, D. B. ROY, M. G. TELFER, S. JEFFCOATE, P. HARDING, G. JEFFCOATE, S. G. WILLIS, J. N. GREATOREX-DAVIES, D. MOSS & C. D. THOMAS. 2001. Rapid responses of British butterflies to opposing forces of climate and habitat change. *Nature* 414: 65–69.

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ARSENURINAE AND CERATOCAMPINAE (SATURNIIDAE) OF RIO GRANDE DO SUL STATE, BRAZIL

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ABSTRACT. The present work aims to offer a list of Arsenurinae and Ceratocampinae species known to occur in Rio Grande do Sul, Brazil. The list is based on bibliographical data, newly collected specimens, and previously existing museum collections. The Arsenurinae are listed in the following genera (followed by number of species): *Arsenura* Duncan, 1841 (4), *Caio* Travassos & Noronha, 1968 (1), *Dysdaemonia* Hübner, [1819] (1), *Titaea* Hübner, [1823] (1), *Paradaemonia* Bouvier, 1925 (2), *Rhescyntis* Hübner, [1819] (1), *Copiopteryx* Duncan, 1841 (2). Ceratocampinae are listed in *Adeloneivaia* Travassos, 1940 (3), *Adelowalkeria* Travassos, 1941 (2), *Almeidella* Oiticica, 1946 (2), *Cicia* Oiticica, 1964 (2), *Citheronia* Hübner, [1819] (4), *Citioica* Travassos & Noronha, 1965 (1), *Eacles* Hübner, [1819] (4), *Mielkesia* Lemaire, 1988 (1), *Neocarnegia* Draudt, 1930 (1), *Oiticella* Travassos & Noronha, 1965 (1), *Othorene* Boisduval, 1872 (2), *Procitheronia* Michener, 1949 (1), *Psilopygida* Michener, 1949 (2), *Scolesa* Michener, 1949 (3) and *Syssphinx* Hübner, [1819] (1). *Rhescyntis pseudomartii* Lemaire, *Titaea tamerlan tamerlan* (Maassen), *Eacles bertrandi* Lemaire, *Eacles mayi* Schaus and *Mielkesia paranaensis* (Rego-Barros & Mielke) are new records for Rio Grande do Sul. To facilitate identification we provide photographs, morphological characteristics of each species, and dichotomous keys. Also, we discuss briefly their distribution and the inventorying status of Lepidoptera in Rio Grande do Sul.

Additional key words: inventory, biodiversity, distribution, survey

The Saturniidae are among the world's most popular and beautiful groups of moths, with an enormous variety of sizes, shapes and colors. Their beauty and peculiarity have attracted many lepidopterists, making them relatively well studied and frequently collected. The Neotropical Region, despite Lemaires' extensive work (1980, 1988, 1996), is poorly documented in some places. In this paper we present a study of the Arsenurinae and Ceratocampinae of Rio Grande do Sul, the southern-most Brazilian State, a region with limited documentation.

The Lepidoptera survey from Rio Grande do Sul started at the end of the nineteenth century with publications by Weymer (1894) and Mabilde (1896). Later, Ronna (1923, 1933) and Biezanko and collaborators (1939, 1948, 1949, 1957, 1986) made important contributions throughout much of the

twentieth century. The collections of Mabilde and Ronna are at the Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul, in Porto Alegre, and Biezanko's material is deposited at the Museu Entomológico Ceslau Biezanko, in Pelotas. The present study aimed to update the existing lists of Arsenurinae and Ceratocampinae in Rio Grande do Sul, to identify diagnostic characters for these species, and to map their distribution in the State.

Arsenurinae

The species of the Arsenurinae Jordan, 1922 are generally large with a robust body and gray or brown ground color; the most significant external feature is the variable shape of the wings, especially the hindwing, which is more or less prominently tailed in most of the species (Lemaire, 1980). They contain large and

protuberant mandibular rudiments; the tibial epiphysis is about half as long as the tibia; the forewing has the discal cell closed, vein M1 not or only briefly stalked with radius, M2 arising from the cell at about the middle of outer margin; vein 3A of the hindwing is very short or absent (Michener 1952; Lemaire 1980).

According to Silva *et al.* (1968) and Stone (1991), the caterpillars are polyphagous, feeding on Annonaceae, Euphorbiaceae, Lauraceae, Malvaceae, Myristicaceae, Sapindaceae and Sapotaceae. The species *Arsenura xanthopus*, according to Mariconi & Lordello (1953), was considered a pest of *Luhea divaricata* Mart in the southern part of Brazil.

The Arsenurinae are exclusively distributed in the Neotropical region (Michener 1952; Lemaire 1980, 1996), being well-represented in southern Brazil where about 36% of the known species occur (Lemaire 1980). There are 58 known species of Arsenurinae, 27 of which have been reported for Brazil (Lemaire 1996).

Ceratocampinae

The species of Ceratocampinae Harris, 1841 are generally characterized by the peculiar structure of the male's antennae, usually sphingiform wings of males, and the comparatively long and heavy body in both sexes. They are extremely variable in size, including some of the smallest as well as some of the largest American Saturniidae (Lemaire 1988).

The antennae of the male are quadripectinate for about the three-fifths of the flagellum and then simple to the apex; the female's antennae either are like those of the males or simple. There are three or four radial branches in the venation of the forewing; the discal cell is closed; vein M1 is basally stalked with the radials, M2 arises in front of the middle of the apex of the discal cell; vein 3A of the hindwing is present; veins CuA1 and CuA2 arise directly from the cell (Michener 1952; Lemaire 1988).

The caterpillars are polyphagous, feeding on Anacardiaceae, Aquifoliaceae, Asteraceae, Betulaceae, Burseraceae, Caprifoliaceae, Caryocaraceae, Cochlospermaceae, Combretaceae, Cupressaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Fagaceae, Hamamelidaceae, Juglandaceae, Lauraceae, Loranthaceae, Malvaceae, Melastomataceae, Moraceae, Myricaceae, Myrtaceae, Oleaceae, Pinaceae, Platanaceae, Rosaceae, Rubiaceae, Salicaceae, Sapindaceae, Sapotaceae and Ulmaceae (Silva *et al.* 1968; Stone 1991; Pastran 2004). According to Gallo *et al.* (2002), *Citheronia laocon* (Cramer, 1777) and *Eacles imperialis magnifica* Walker, 1855 were considered pests, the former of *Psidium guajava* (L.)

and *Psidium cattleianum* (Sabine) and the latter of *Coffea arabica* L. The larvae are remarkable for their hypertrophy of the armature, especially in the early instars, which has been dubbed "diabolic"; the pupae are more or less deeply situated in the soil, they usually have spines which certainly help them ascend to the surface of the soil just prior to emergence of the imago (Lemaire 1988).

According to Lemaire (1988), Ceratocampinae are widely distributed from southern Canada to northern Argentina, being well-represented in southeastern Brazil and adjacent areas; there are 170 known species in 27 genera, 86 of which have been reported for Brazil.

Rio Grande do Sul

Rio Grande do Sul has an area of 282.184 km² and represents 3.32% of the Brazilian territory. It is the southern-most State of Brazil, where the northern extreme lies at latitude of 27°03'42" and the southern limit at 33°45'09". The weather has been characterized as mesothermic humid, without a dry season and highly humid in some areas.

The climate uniformity across the State is a striking feature. The dynamic factors are represented by atmospheric circulation, especially the Atlantic and Polar anticyclone masses of air. Static factors carry out local influences. Maximum temperature averages are 21°C to 25°C, and minimum 10°C to 14°C, with extremes being determined by latitude and altitude; at higher altitudes, mainly in northeast, low temperatures reach 4°C, and, in the plain, the highest are above 35°C. Snowfall is occasional, but frost in winter is frequent. Precipitation is regularly distributed over the year, with a monthly average between 100mm and 150mm (Vieira 1984).

The north-northeast portion of Rio Grande do Sul includes the southern extent of the Atlantic forest biome, comprising 37.4% of the State. This region has a mountainous relief rising from the sandstone-basaltic plateau. The altitude varies from 400m to a bit more than 1000m, with the highest elevations located in the northeast. The vegetation is represented mainly by *Araucaria* moist forest, deciduous tropical forest and semi-deciduous tropical forest, with a small portion of Atlantic moist forest near the coast.

The Pampa biome, which also includes Uruguay and part of Argentina, is responsible for the remaining 63.6% of the State. The geomorphology of this region includes the Central Depression located below the sandstone-basaltic plateau, the Campain Plateau in the west-southwest, with altitudes rarely above 200m, the South-riograndense Plateau (Riograndense Shield),

with average altitudes from 200m to 400m, and, finally, the Coastal Plain. The vegetation is characterized by fields and savannas, with some portions of semi-deciduous tropical forest.

Details about the vegetation of Rio Grande do Sul are presented in Figure 1.

MATERIALS AND METHODS

Data were obtained from bibliographical sources, newly collected specimens and analysis of 534 specimens in the collections of Centro de Pesquisa Agropecuário Clima Temperado da Embrapa (CAMB), Museu Científico da Universidade Católica de Pelotas (MUCP) and Museu Entomológico Ceslau Biezanko (MECB), in Pelotas; Museu Anchieta de Porto Alegre (MAPA), Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCTP), Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (MCNZ), Museu Ramiro Gomes Costa da Fundação Estadual de Pesquisa Agropecuária (MRGC) and Setor de Entomologia da Faculdade de

Agronomia da Universidade Federal do Rio Grande do Sul (FASE), in Porto Alegre; Coleção Lepidoptera Alfred Moser (CLAM), in São Leopoldo; Departamento de Zoologia da Universidade Federal do Paraná (DZUP), in Curitiba; Museu de Zoologia da Universidade de São Paulo (MZSP), in São Paulo and Museu Nacional da Universidade Federal do Rio de Janeiro (MNRJ), in Rio de Janeiro.

Specimens were identified based on the current sources (Draudt 1929–30; Lemaire 1988; D'Abreu 1995) and comparisons with specimens in the collections listed above. Nomenclature follows Lemaire (1996). Measurements of forewing length were taken for the specimens observed in the collections from Porto Alegre and São Leopoldo. Hostplant family information was gathered from Silva *et al.* (1968), Stone (1991) and Pastran (2004).

Species are listed following the arrangement of Lemaire (1996); “f” indicates female and “m” male. New records for Rio Grande do Sul are identified with an asterisk.

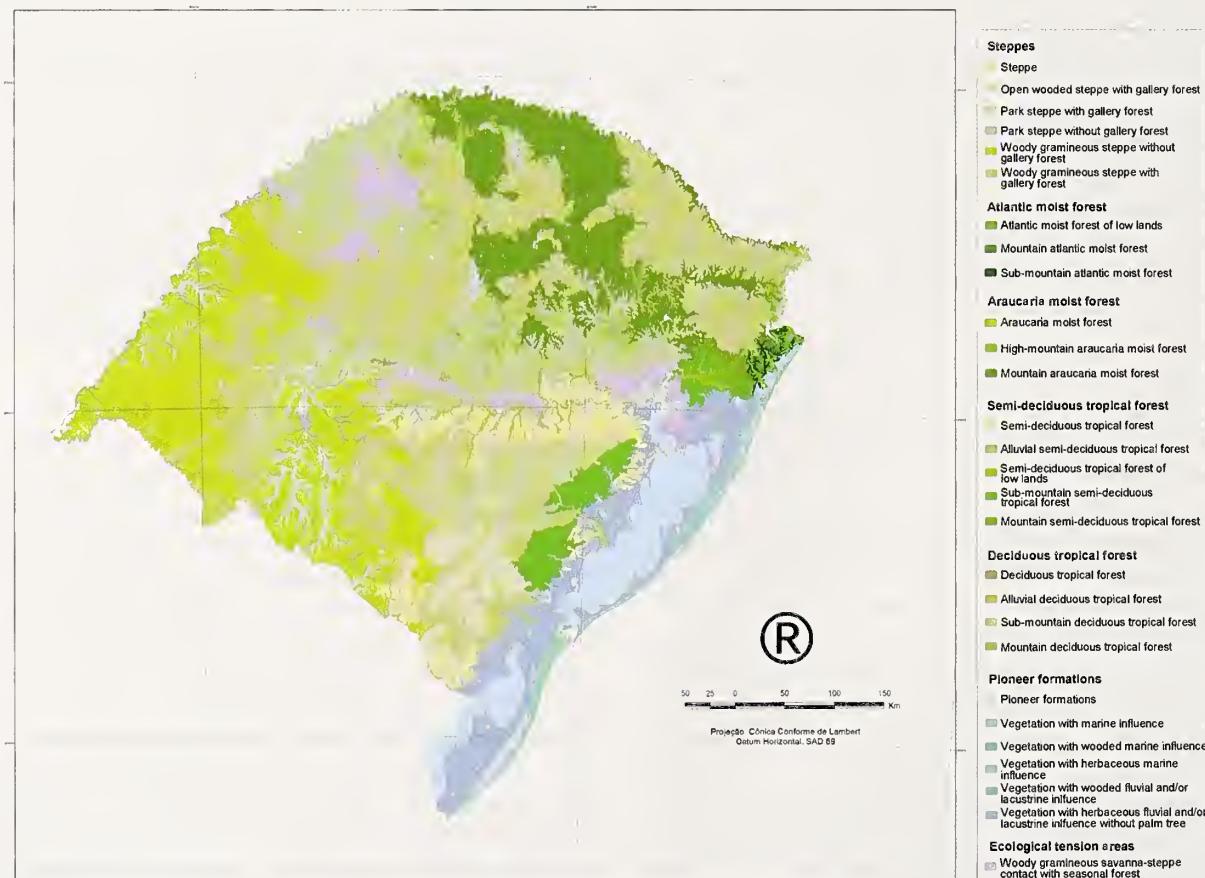


FIG. 1. Simplified map of the vegetation of Rio Grande do Sul. Following Projeto Radambrasil - IBGE (1986).

RESULTS

The available evidence indicates that 12 species of 7 genera for Arsenurinae and 30 species of 15 genera for Ceratocampinae occur in Rio Grande do Sul.

Arsenurinae Jordan, 1922***Arsenura armida* (Cramer, 1779) – Fig. 4.**

Rhescyntis erythrina; Mabilde (1896)

Arsenura erythrinae; Costa Lima (1936)

Rhescyntis erythrinae; Silva *et al.* (1968)

Rhescyntis (Arsenura) armida; Biezanko (1986)

Forewing length - f: 75.4mm [according to illustration by Lemaire (1980)]; m (9): 63.6 ± 1.2 mm.

Host families: Annonaceae, Euphorbiaceae, Malvaceae.

Flight period: January to March, June, September and October.

Material examined. Porto Alegre, (no date), (no collector), 1 m (MZSP); Santa Maria, 15.i.1926, (no collector), 1 m (MCNZ); Caxias do Sul, 1932, (no collector), 1 m (MCNZ); Pelotas, 15.i.1939, Irmãs Figueiredo leg., 1 m (CAMB); Pelotas, ii.1939, Irmãs Figueiredo leg., 1 m (CAMB); Santa Maria, 09.iii.1971, S. Bressan leg., 1 m (MECB); Santa Maria, 15.i.1973, S. Carvalho leg., 1 m (MECB); Pelotas, 12.i.1975, A. Witauper leg., 1 m (MECB); Pelotas, 12.vi.1976, Edison leg., 1 m (MECB); Morro Reuter, 02.i.1983, A. Moser leg., 3 m (CLAM); Morro Reuter, 09.i.1983, A. Moser leg., 1 m (CLAM); Passo Fundo, 07.ix.1994, A. C. P. Peres leg., 1 m (MCTP); Iraí, 27.x.1998, A. Specht leg., 1 m (MCTP); Derrubadas, 24.i.2001, R. Di Mare leg., 1 m (MCTP); Morro Reuter, 17–19.i.2005, A. Moser leg., 1 m (CLAM).

***Arsenura biundulata* Schaus, 1906 – Fig. 5.**

Lemaire (1980); Lemaire (1996); Nunes *et al.* (2003)

Rhescyntis (Arsenura) biundulata; Biezanko (1986)

Forewing length - f (2): 88.3 ± 0.3 mm; m (27): 83.8 ± 0.6 mm.

Flight period: January to May.

Material examined. Canoas, (no date), (no collector), 1 m (MCNZ); Porto Alegre, (no date), A. Miranda leg., 1 f (MZSP); Porto Alegre, (no date), A. Miranda leg., 1 m (MZSP); Caxias do Sul, (no date), (no collector), 1 m (MAPA); Caxias do Sul, 25.iv.1927, (no collector), 1 m (MCNZ); Porto Alegre, 29.i.1934, A. Baumann leg., 1 f (DZUP); Pareci Novo, 08.v.1937, (no collector), 1 m (MAPA); Charqueadas, iii.1941, (no collector), 1 m (MAPA); Porto Alegre, 10.iv.1961, C. Mario leg., 1 m (FASE); Porto Alegre, iv.1962, C. Sallenave leg., 1 m (FASE); Porto Alegre, 15.i.1946, A. Baumann, 1 m (DZUP); Pelotas, 21.iii.1957, Modernell leg., 1 m (MECB); Camela, 19.i.1964, F. Luca leg., 1 m (FASE); Dois Irmãos, 01.v.1971, D. Scholla leg., 1 m (FASE); Porto Alegre, 06.iv.1964, S. Manfredini leg., 1 f (FASE); Porto Alegre, 10.v.1964, Leonir leg., 1 m (FASE); Porto Alegre, 20.iv.1968, R. Baerver leg., 1 m (MCTP); Pelotas, 15.ii.1971, M. Elias leg., 1 m (MECB); Porto Alegre, 21.iv.1971, C. B. Costa leg., 1 f (FASE); Porto Alegre, 23.iv.1971, Neuremberg leg., 1 m (FASE); Porto Alegre, 29.iv.1971, E. Soares leg., 1 m (FASE); Porto Alegre, 29.iv.1971, N. Cortes leg., 1 m (FASE); Santa Maria, 16.iv.1973, S. Carvalho leg., 1 m (MECB); Porto Alegre, 20.v.1975, Illegible leg., 1 m (FASE); Pelotas, 12.iii.1983, Reinhardt leg., 1 m (MECB); São Francisco de Paula, 11.ii.1999, A. Specht leg., 6 m (MCTP); São Francisco de Paula, 12.ii.1999, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 12.ii.1999, A. Specht leg., 1 m (MCTP).

***Arsenura orbigniana* (Guérin-Méneville, 1844) –**

Fig. 6.

Lemaire (1980)

Forewing length - f: 64.8mm [according to illustration by Lemaire (1980)]; m (8): 61.2 ± 0.8 mm.

Flight period: January, February, May, September to November.

Material examined. Porto Alegre, (no date), (no collector), 1 m (MZSP); Estrela, 20.xi.1919, (no collector), 1 m (MAPA); Pareci Novo, 21.x.1933, (no collector), 1 m (MAPA); Santa Cruz do Sul, 29.ii.1937, A. Baumann leg., 1 f (DZUP); Pareci Novo, x.1945, (no collector), 1 m (MAPA); Santa Cruz do Sul, 29.i.1946, A. Baumann leg., 1 m (DZUP); Pareci Novo, x.1947, (no collector), 1 m (MAPA); Pelotas, 05.x.1975, J. Paludo leg., 1 m (MECB); Pelotas, 10.x.1976, (no collector), 1 m (MECB); Porto Alegre, 13.v.1977, (no collector), 1 m (MAPA); Morro Reuter, 26.ix.1983, A. Moser leg., 2 m (CLAM); Erechim, 08.xi.1985, Mielke & Casagrande leg., 2 m (DZUP); Morro Reuter, 20.x.2001, A. Moser leg., 1 m (CLAM).

***Arsenura xanthopus* (Walker, 1855) – Fig. 7.**

Rescynnis (Arsenura) xanthopus; Biezanko (1986)

Forewing length - f: 67.2mm [according to illustration by Lemaire (1980)]; m (6): 63.3 ± 0.5 mm.

Host family: Malvaceae.

Flight period: January, February, September, October and December.

Material examined. Porto Alegre, (no date), (no collector), 1 f (MNRJ); Porto Alegre, (no date), (no collector), 1 m (MNRJ); Santa Maria, 02.xii.1970, D. Link leg., 1 m (MECB); Santa Cruz do Sul, 26.ix.1971, D. Schöninger leg., 1 m (MECB); Santa Maria, 12.x.1971, Sidnei leg., 1 m (MECB); Pelotas, 30.x.1976, J. Paiz leg., 1 m (MECB); Morro Reuter, 25.ix.1982, A. Moser leg., 1 m (CLAM); Bento Gonçalves, 17.x.1985, L. Juruema leg., 1 m (MRCC); Bento Gonçalves, 17.x.1985, L. Juruema leg., 1 m (MRCC); Salvador do Sul, 07.ii.1998, A. Specht leg., 1 m (MCTP); Piratini, 07.x.1999, A. Specht leg., 1 m (MCTP); Morro Reuter, 11.x.1999, A. Moser leg., 1 m (CLAM); Morro Reuter, 8–9.x.2004, A. Moser, 1 m (CLAM); Morro Reuter, 17–19.i.2005, A. Moser leg., 1 m (CLAM).

***Caio romulus* (Maassen, 1869) – Fig. 8.**

Nunes *et al.* (2003)

Forewing length - f: 89.1mm [according to illustration by Lemaire (1980)]; m (1): 83.5mm.

Flight period: October.

Material examined. São Francisco de Paula, 11.x.1996, A. Specht leg., 1 m (MCTP 7713); Maquine, 10.x.2004, Quadros & Moser leg., 1 m (CLAM); São Francisco de Paula, 24–25.x.2005, A. Moser leg., 1 m (CLAM).

***Dysdaemonia brasiliensis* W. Rothschild, 1906 – Fig. 9.**

As *Dysdaemonia boreas* (Cramer) *misidentification; Biezanko (1986) (see discussion below).

Forewing length - f: 62.6mm [according to illustration by Lemaire (1980)]; m (2): 65.1 ± 0.2 mm.

Flight period: January and February.

Material examined. Pelotas, 12.i.1970, J. Ferro leg., 1 m (MECB); Derrubadas, 24.i.2001, R. Di Mare leg., 2 m (MCTP); Derrubadas,

1–6.ii.09, Moser leg., 2 m (CLAM).

**Titaea tamerlan tamerlan* (Maassen, 1869) – Fig. 10.

Forewing length - f: 90.5mm [according to illustration by Lemaire (1980)]; m: 78.9mm.

Flight period: February.

Host family: Malvaceae.

Material examined. São Francisco de Paula, 23.ii.1998, A. Specht leg., 1 m (MCTP).

Paradaemonia meridionalis A. J. A. Camargo, Mielke & Casagrande, 2007 - Fig. 11.

A. J. A. Camargo, Mielke & Casagrande (2007)

Forewing length - f: 74–79mm [according to A. J. A. Camargo *et al.* (2007)]; m (2): 67.6 ± 2.4 mm.

Flight period: January and February.

Material examined. São Francisco de Paula, i.1955, L. E. Buckup leg., 1 m (MCNZ); Barracão, 21.ii.2001, R. Di Mare leg., 1 m (MCTP); São Francisco de Paula, 24.i.2006, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 24.i.2006, A. Moser leg., 1 m (MCTP).

Paradaemonia thelia (Jordan, 1922) – Fig. 12.

Biezanko & Baucke (1948); Lemaire (1980)

Dysdaemonia thelia; Draudt (1929–30)

Rhescyntis (*Paradaemonia*) *wagneri*; Biezanko (1986)

Forewing length - f (1): 67.3mm; m (19): 58.7 ± 0.6 mm.

Flight period: February to April, June, and

September to November.

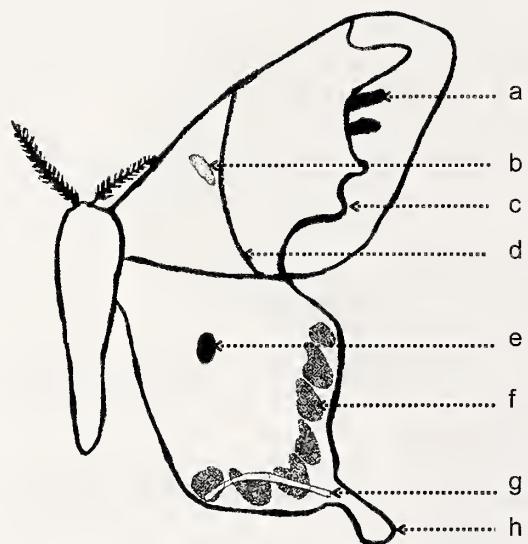
Material examined. São Lourenço do Sul, (no date), (no collector), 1 m (MNRJ); Santa Maria, 1925, (no collector), 1 m (MCNZ); São Leopoldo, x.1932, (no collector), 1 m (MAPA); Pareci Novo, 15.x.1936, (no collector), 1 m (MAPA); Pelotas, 13.ii.1942, Irmãs Figueiredo leg., 1 m (MUCP); Pelotas, 23.iii.1944, Irmãs Figueiredo leg., 1 m (MUCP); Pelotas, xi.1944, Irmãs Figueiredo leg., 1 m (MUCP); Porto Alegre, 30.x.1946, M. Faesch leg., 1 m (MECB); Porto Alegre, 16.x.1958, E. Corseuil leg., 1 m (FASE); Porto Alegre, 08.x.1966, (no collector), 1 m (MAPA); Porto Alegre, 06.iii.1967, (no collector), 1 m (MAPA); Santa Maria, 07.vi.1968, J. Mantovani leg., 1 m (MECB); Porto Alegre, 03.x.1969, Stoffel leg., 1 f (MAPA); Porto Alegre, 10.x.1969, Stoffel leg., 1 m (MAPA); Santa Maria, 09.x.1971, C. Rizzato leg., 1 m (MECB); Santa Maria, 14.x.1971, A. Aita leg., 1 m (MECB); Porto Alegre, 15.vi.1974, Mello leg., 1 m (MAPA); Porto Alegre, 13.x.1977, E. Borsa leg., 1 m (MCNZ); Pelotas, 04.x.1978, M. Rodrigues leg., 1 m (MECB); Pelotas, 16.x.1980, M. Romilda leg., 1 m (MECB); Pelotas, 13.iv.1981, A. Lanz leg., 1 m (MECB); São Jerônimo, 10.ix.1982, T. Arigony leg., 1 m (MCNZ); São Jerônimo, 20.ix.1982, H. A. Gastal leg., 1 m (MCNZ); São Jerônimo, 23.ix.1982, H. A. Gastal leg., 1 m (MCNZ); Morro Reuter, 25.ix.1982, A. Moser leg., 1 m (CLAM); São Jerônimo, 01.x.1982, C. J. Becker leg., 1 m (MCNZ); São Jerônimo, 11.x.1982, C. J. Becker leg., 1 m (MCNZ); São Jerônimo, 13.x.1982, H. A. Gastal leg., 1 m (MCNZ); Pelotas, 01.iii.1983, Jacira leg., 1 m (MECB); Porto Alegre, 04.xi.1992, P. R. Rambo leg., 1 m (MCTP); Cachoeira do Sul, 21.ix.1998, A. Specht leg., 1 m (MCTP); Alegrete, 23.xi.2000, R. Di Mare leg., 1 m (MCTP); Alegrete, 24.xi.2000, R. Di Mare leg., 1 m (MCTP).

**Rhescyntis pseudomartii* Lemaire, 1976 – Fig. 13.

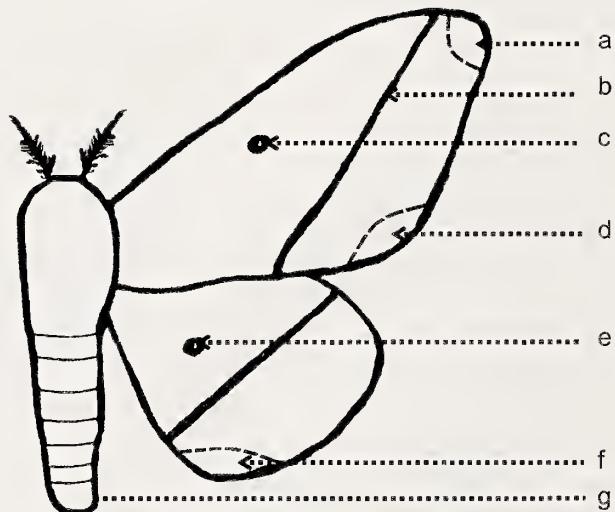
Forewing length - f: 81.7mm [according to illustration by Lemaire (1980)]; m: 85.7mm.

Flight period: April.

Material examined. São Francisco de Paula, 19.iv.2004, F. Nunes leg., 1 m (MCTP).

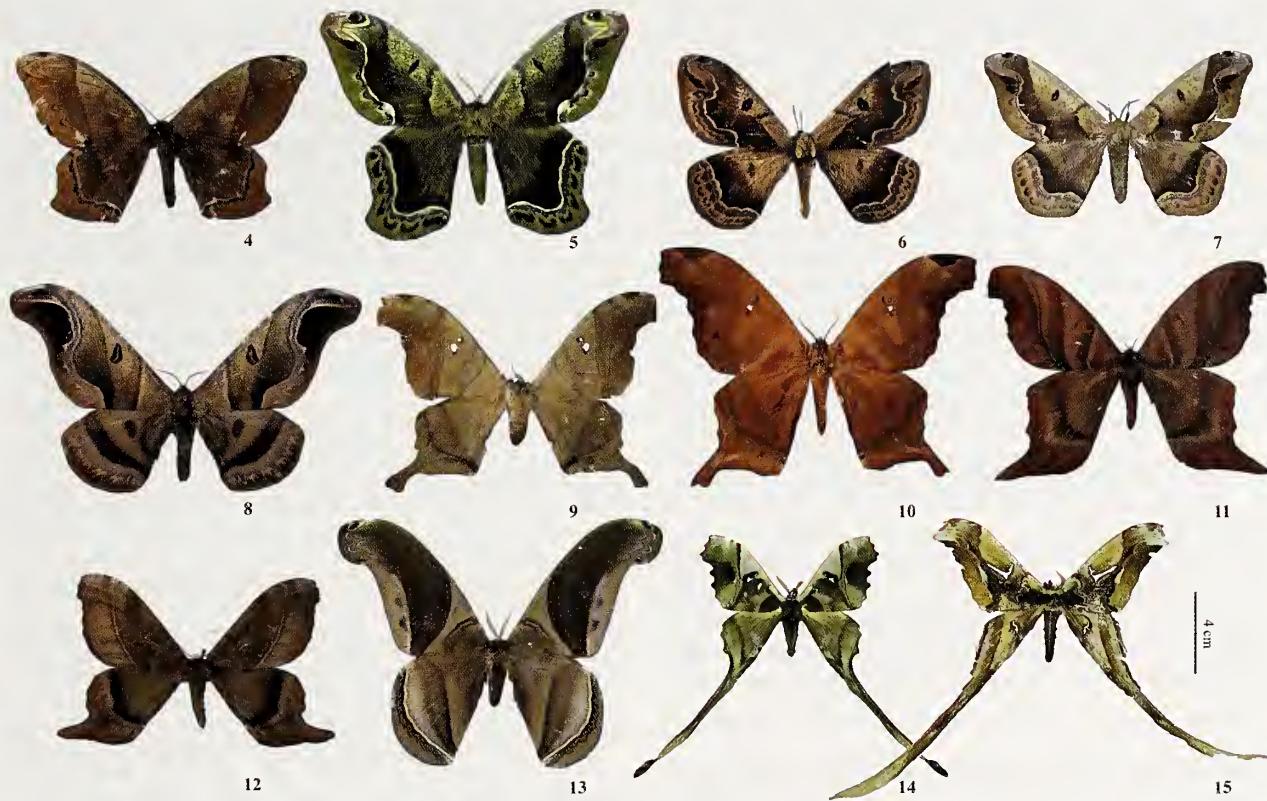


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Figs. 2–3. Some morphological aspects used in the dichotomous keys. 2. Arsenurinae. a) submarginal black spot between M1 and M2; b) forewing discal spot; c) convexities between M3–CuA2 on the submarginal band; d) hindwing discal spot; e) clear interveinous mark on the submarginal region; f) concave line on the anal angle to wing prolongation; g) hindwing prolongation. 3. Ceratocampinae. a) apex; b) distal band; c) forewing subcircular discal spot; d) forewing tornus; e) hindwing subcircular discal spot; f) hindwing tornus; g) abdomen.



FIGS. 4–15. Figs. 4–9. Arsenurinae of Rio Grande do Sul, Brazil (male dorsal view). **4.** *Arsenura armida*. **5.** *Arsenura biundulata*. **6.** *Arsenura orbygniana*. **7.** *Arsenura xanthopus*. **8.** *Caio romulus*. **9.** *Dysdaemonia brasiliensis*. Figs. 10–15. Arsenurinae of Rio Grande do Sul, Brazil (male dorsal view). **10.** *Titaea tamerlan tamerlan*. **11.** *Paradaemonia meridionalis*. **12.** *Paradaemonia thelia*. **13.** *Rhescyntis pseudomartii*. **14.** *Copiopteryx sonthonnaxi*. **15.** *Copiopteryx derceto*.



FIGS. 16–26. Ceratocampinae of Rio Grande do Sul, Brazil (male dorsal view). **16.** *Eacles imperialis magnifica*. **17.** *Eacles ducalis*. **18.** *Eacles mayi*. **19.** *Eacles bertrandii*. **20.** *Citheronia brissotti brissotti*. **21.** *Citheronia johnsoni* (cf. D'Abreu 1995). **22.** *Citheronia laocoon*. **23.** *Citheronia vogleri* (cf. D'Abreu 1995). **24.** *Procitheronia purpurea*. **25.** *Othorene cadmus*. **26.** *Othorene purpurascens*.

***Copiopteryx sonthronnaxi* É. André, 1905 – Fig. 14.**
Biezanko (1986)

Forewing length - f (1): 53.5mm; m (17): 49.7 ± 0.3 mm.

Host family: Lauraceae.

Flight period: every month except May and December.

Material examined. Osório, (no date), (no collector), 1 m (MCNZ); Lajeado, 14.viii.1900, Mabilde leg., 1 m (MCNZ); Porto Alegre, 05.ix.1928, (no collector), 1 m (MAPA); Taquara, 03.ii.1929, A. Baumann leg., 1 m (DZUP); Pareci Novo, 16.vii.1933, (no collector), 1 m (MAPA); Porto Alegre, 19.iii.1939, (no collector), 1 m (MAPA); São Leopoldo, x.1940, (no collector), 1 f (MAPA); São Leopoldo, x.1940, (no collector), 1 m (MAPA); Bento Gonçalves, iii.1954, J. Steiger leg., 1 m (MCNZ); Porto Alegre, 20.viii.1957, J. Azerolo leg., 1 m (FASE); Porto Alegre, 23.vii.1962, (no collector), 1 m (FASE); Porto Alegre, 27.x.1969, A. Gentilli leg., 1 m (DZUP); Porto Alegre, 17.ix.1980, L. Ramos leg., 1 m (FASE); Morro Reuter, 28.X.1982, A. Moser leg., 1 m (CLAM); Pelotas, vi.1986, P. Peterle leg., 1 m (MECB); São Pedro do Sul, 04.ii.1994, A. Specht leg., 1 m (MCTP); Salvador do Sul, 04.x.1995, A. Specht leg., 1 m (MCTP); Morro Reuter, 12–19.iv.1997, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 20.xi.1998, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 19.iii.2001, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 20.iii.2004, F. G. Nunes leg., 1 m (MCTP); Pelotas, 20.i.2005, A. Moser leg., 1 m (CLAM).

***Copiopteryx derceto* (Maasen, [1872]) – Fig. 15.**
Nunes *et al.* (2003)

Forewing length - f: 64.4mm [according to illustration by Lemaire (1980)]; m (4): 67.3 ± 2 mm.

Flight period: January, March, and November.

Material examined. São Francisco de Paula, 06.i.1997, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 07.i.1997, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 20.xi.1998, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 19.i.2001, R. Di Mare leg., 1 m (MCTP); Maquine, 6–7.iii.2005, A. Moser leg., 1 m (CLAM).

Ceratocampinae Harris, 1841

***Eacles imperialis magnifica* Walker, 1855 – Fig. 16.**

Costa Lima (1936); Biezanko; Baucke (1948);

Biezanko *et al.* (1949); Silva *et al.* (1968);

Nunes *et al.* (2003)

Eacles magnifica; Mabilde (1896); Ronna (1923);
Ronna (1933)

Forewing length - f (14): 60.1 ± 2.3 mm; m (34): 53.3 ± 0.4 mm.

Host families: Anacardiaceae, Betulaceae, Burseraceae, Caprifoliaceae, Cochlospermaceae, Combretaceae, Cupressaceae, Ebenaceae, Euphorbiaceae, Fabaceae: Caesalpinoideae, Fabaceae: Faboideae, Fagaceae, Hamamelidaceae, Juglandaceae, Lauraceae, Malvaceae, Moraceae, Myricaceae, Myrtaceae, Oleaceae, Pinaceae, Platanaceae, Rosaceae, Rubiaceae, Salicaceae, Sapindaceae, Ulmaceae.

Flight period: every month except June and July.

Material examined. Cerro Largo, (no date), (no collector), 3 m (MAPA); São Francisco de Paula, (no date), (no collector), 2 f (MAPA); Estrela, ix.1919, (no collector), 1 m (MAPA); Estrela, 20.ix.1919, (no collector), 1 m (MAPA); Estrela, 24.ix.1919, (no collector), 1 f (MAPA); Estrela, 02.xii.1919, (no collector), 1 f (MAPA); Estrela, 15.xii.1919, (no collector), 1 f (MAPA); Porto Alegre, 11.ix.1929, (no collector), 1 m (MAPA); Pareci Novo, 05.ix.1933, (no collector), 1 m (MAPA); Pareci Novo, 02.x.1936, (no collector), 1 f (MAPA); Pelotas, 22.ii.1939, I. Figueiredo leg., 1 m (MUCP); Pelotas, 24.ii.1939, I. Figueiredo leg., 1 f (MUCP); São Leopoldo, v.1940, (no collector), 1 m (MAPA); Porto Alegre, 18.ix.1940, (no collector), 1 m (MAPA); São Francisco de Paula, 31.i.1941, (no collector), 1 m (MAPA); Pelotas, xi.1942, I. Figueiredo leg., 1 f (MUCP); Porto Alegre, 27.ii.1943, R.G. Costa leg., 1 m (MRCC); Pelotas, 16.x.1944, I. Figueiredo leg., 1 m (MUCP); Pelotas, 15.iii.1945, I. Figueiredo leg., 1 f (MUCP); Porto Alegre, 1946, (no collector), 1 m (MAPA); Pareci Novo, 21.viii.1946, (no collector), 1 f (MAPA); Pelotas, 23.ix.1946, C. Biezanko leg., 2 m (MECB); Pelotas, 31.x.1946, C. Biezanko leg., 1 m (MECB); Pelotas, 25.ii.1948, I. Figueiredo leg., 1 m (MUCP); Pelotas, 06.iii.1950, I. Figueiredo leg., 1 m (MUCP); Porto Alegre, 19.x.1951, D.C. Radaelli leg., 1 f (MRGC); Montenegro, 07.ii.1953, O. Baucke leg., 1 m (MRGC); Montenegro, 07.ii.1953, O. Baucke leg., 2 f (MRGC); Santa Maria, 15.iii.1956, O.R. Camargo leg., 1 m (MRGC); Porto Alegre, 17.iii.1958, E. Corseuil leg., 1 m (FASE); Porto Alegre, 17.iii.1958, E. Corseuil leg., 1 m (FASE); Porto Alegre, 11.v.1960, C. Barrada leg., 1 m (FASE); Porto Alegre, 20.x.1965, L. Wisse leg., 1 m (FASE); Porto Alegre, 24.viii.1972, C. Trois leg., 1 m (FASE); Porto Alegre, 15.viii.1978, Valdir leg., 1 f (FASE); Taquarí, 12.ix.1980, J. Müller leg., 1 f (FASE); Morro Reuter, 25.ix.1982, A. Moser leg., 1 m (CLAM); Cassino, 31.i.1988, (no collector), 1 m (MCNZ); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Salvador do Sul, 03.iv.1994, A. Specht leg., 1 m (MCTP); Salvador do Sul, 13.viii.1994, A. Specht leg., 1 m (MCTP); Morro Reuter, 08.x.1994, A. Moser leg., 1 m (CLAM); Morro Reuter, 24.ii.1996, A. Moser leg., 1 f (CLAM); São Francisco de Paula, 11.x.1996, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 11.x.1996, A. Specht leg., 1 f (MCTP); Encruzilhada do Sul, 02–03.xi.2000, A. Moser leg., 1 m (CLAM); Derrubadas, 24.i.2001, R. A. Di Mare leg., 1 m (MCTP); São Francisco de Paula, 20.iii.2004, F. G. Nunes leg., 2 m (MCTP).

***Eacles ducalis* (Walker, 1855) – Fig. 17.**

Nunes *et al.* (2003)

Forewing length - f (1): 65mm; m (35): 53.5 ± 0.5 mm.

Host families: Anacardiaceae, Fagaceae, Juglandaceae, Loranthaceae, Malvaceae, Melastomataceae, Oleaceae, Poaceae.

Flight period: January to March and July to October.

Material examined. Pareci Novo, vii.1932, (no collector), 1 m (MAPA); Pareci Novo, 15.x.1939, (no collector), 1 f (MAPA); São Francisco de Paula, 21.i.1941, (no collector), 1 m (MAPA); São Francisco de Paula, 05.ii.1941, (no collector), 1 m (MAPA); Porto Alegre, 10.x.1947, (no collector), 1 m (MAPA); Lajeado, 12.viii.1948, R.G. Costa leg., 1 m (MRCC); Canela, 13.i.1955, O. Baucke leg., 2 m (MRCC); Porto Alegre, 17.iii.1958, E. Corseuil leg., 1 m (FASE); Porto Alegre, 14.x.1958, E. Corseuil leg., 1 m (FASE); Porto Alegre, 11.vii.1960, E. Corseuil leg., 1 m (FASE); Porto Alegre, 12.x.1961, K. Zimmerman leg., 1 m (FASE – 621); Pelotas, 23.i.1965, Illegible leg., 1 m (MECB); Viamão, 06.iii.1965, R. S. Crillo leg., 1 m (FASE); Porto Alegre, 11.vii.1966, (no collector), 1 m (MAPA); Porto Alegre, 20.viii.1967, Rópero leg., 1 m (FASE); Viamão, 10–15.ix.1972, T. M. Pereira leg., 1 m (FASE); Porto Alegre, 11.ix.1972, C. Trois leg., 1 m (FASE); Porto Alegre, 25.viii.1975, Voigt leg., 1 m (FASE); Porto Alegre, 12.ix.1977, Bianchin leg., 1 m (FASE); Salvador do Sul, 08.x.1994, A. Specht leg., 1 m (MCTP); Morro Reuter, 19.ii.1996, A. Moser leg., 1 m (CLAM); Morro Reuter, 03.i.1998, A. Moser leg., 1 m (CLAM); Camaquã, 20.viii.1998, A. Specht leg., 1 m (MCTP); Piratini, 14.i.1999, A. Specht leg., 1 m

(MCTP); São Francisco de Paula, 11.ii.1999, A. Specht leg., 1 m (MCTP); Morro Reuter, 29.vii.1999, A. Moser leg., 1 m (CLAM); Piratini, 11.ix.1999, A. Specht leg., 2 m (MCTP); Piratini, 07.x.1999, A. Specht leg., 3 m (MCTP); Encruzilhada do Sul, 02–03.i.2000, A. Moser leg., 1 m (CLAM); Morro Reuter, 18.viii.2001, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 20.iii.2004, F. G. Nunes leg., 2 m (MCTP); Encruzilhada do Sul, 4–6.ix.2004, A. Moser leg., 1 m (CLAM).

***Eacles mayi Schaus, 1920** – Fig. 18.

Forewing length - f: 98–114mm [wingspan according to Lemaire (1988)]; m (3): 39.5 ± 0.4 mm.

Flight period: January, September, October and November.

Material examined. São Francisco de Paula, 21.i.1942, (no collector), 1 m (MAPA); Porto Alegre, 14.xi.1960, A. Baumann leg., 1 f (DZUP); São Francisco de Paula 11.x.1996, A. Specht leg., 1 m (MCTP); São Francisco de Paula 10.ix.1999, A. Specht leg., 1 m (MCTP).

***Eacles bertrandi Lemaire, 1981** – Fig. 19.

Forewing length - m (2): 37 ± 1.6 mm.

Flight period: January and February.

Material examined. São Francisco de Paula 23.ii.1998, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 18.i.2005, A. Prestes leg., 1 m (MCTP); Cambará do Sul, 1–4.i.2006, C. Mielke leg., 4 m (CLAM).

Citheronia brissotii brissotii (Boisduval, 1868) – Fig. 20.

Nunes *et al.* (2003)

Forewing length - f (8): 55.5 ± 1.9 mm; m (22): 46.9 ± 0.6 mm.

Hostfamilies: Aquifoliaceae, Euphorbiaceae, Juglandaceae, Oleaceae, Rosaceae.

Flight period: every month except March, May, and June.

Material examined. Porto Alegre, x.1904, (no collector), 1 f (MAPA); Porto Alegre, 03.x.1930, (no collector), 1 f (MAPA); Porto Alegre, 20.ix.1933, (no collector), 1 m (MAPA); Pelotas, 10.xi.1941, I. Figueiredo leg., 1 m (CAMB); Pelotas, 28.ix.1944, I. Figueiredo leg., 1 m (MUCP); Pelotas, 16.x.1944, I. Figueiredo leg., 1 f (MUCP); Pelotas, 10.ii.1945, I. Figueiredo leg., 1 m (MUCP); São Sebastião do Caí, 28.iv.1945, A. Paiva-Neto leg., 1 f (MRGC); Pelotas, iv.1947, E. Poetsch leg., 1 m (MECB); Pelotas, 21.viii.1947, I. Figueiredo leg., 1 m (MUCP); Canoas, 13.viii.1949, (no collector), 1 f (MCNZ); Canela, 13.i.1955, O. Baucke leg., 1 m (MRGC); Porto Alegre, 1956, J. Sousa leg., 1 f (FASE); Porto Alegre, 22.ix.1959, C. Seherer leg., 1 m (FASE); Porto Alegre, 11.vii.1960, (no collector), 1 m (MAPA); Porto Alegre, viii.1962, C. Trois leg., 1 m (FASE); Porto Alegre, 05.ix.1962, M. Barreto leg., 1 m (FASE); Porto Alegre, 05.x.1962, (no collector), 1 m (FASE); Rio Grande, 10.x.1962, (no collector), 1 m (MECB); Lajeado, 28.i.1980, Nilde leg., 1 m (MECB); São Jerônimo, 26.viii.1982, (no collector), 1 m (MCNZ); São Jerônimo, 07.ix.1982, (no collector), 1 m (MCNZ); Rio Grande, 15.x.1985, C. J. Beeker leg., 1 f (MCNZ); Rio Grande, 16.xi.1985, H. A. Gastal leg., 1 m (MCNZ); Rio Grande, 04.xi.1986, A. A. Lise leg., 1 m (MCNZ); Salvador do Sul, 08.x.1994, A. Specht leg., 1 m (MCTP); Venâncio Aires, 13.xii.1995, (no collector), 1 f (MCTP); São Francisco de Paula, 20.xi.1996, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 23.ii.1998, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 11.ix.1998, A.

Specht leg., 1 m (MCTP); Cachoeira do Sul, 21.ix.1998, A. Specht leg., 1 m (MCTP); Camarão, 19.x.1998, A. Specht leg., 1 m (MCTP); Morro Reuter, 20.ix.1999, A. Moser leg., 1 m (CLAM); Piratini, 07.x.1999, A. Specht leg., 2 m (MCTP); Encruzilhada do Sul, 02–03.i.2000, A. Moser leg., 1 m (CLAM); Morro Reuter, 18.viii.2001, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 20.iii.2004, F. G. Nunes leg., 2 m (MCTP); Encruzilhada do Sul, 4–6.ix.2004, A. Moser leg., 1 m (CLAM).

Citheronia johnsoni Schaus, 1928 – Fig. 21.

Draudt (1929–1930); Lemaire (1988); D'Abreu (1995); Lemaire (1996)

Forewing length - f: 108–115mm [wingspan according to Lemaire (1988)]; m: 67–84mm [wingspan according to Lemaire (1988)].

Flight period: November and December.

Material examined. Porto Alegre, 17.xi.1934, Baumann leg., 1 f (MNRJ); Porto Alegre, 02.xii.1954, Baumann leg., 1 f (MNRJ).

Citheronia laocoon (Cramer, 1777) – Fig. 22.

Lemaire (1898)

Citheronia cacicus; Mabilde (1896)

Eacles cassicus; Ronna (1933)

Citheronia laocoon laocoon; Silva *et al.* (1968)

Citheronia (Citheronia) laocoon; Biezanko (1986)

Forewing length - f (2): 56.6 ± 0.1 mm; m (1): 46.2mm.

Host families: Anacardiaceae, Aquifoliaceae, Asteraceae, Caryocaraceae, Combretaceae, Cucurbitaceae, Cupressaceae, Ebenaceae, Euphorbiaceae, Malvaceae, Myrtaceae, Rosaceae.

Flight period: January, February, October and November.

Material examined. Porto Alegre, (no date), (no collector), 1 f (MZSP); Cerro Largo, i.1931, (no collector), 1 f (MAPA); Charqueadas, ii.1948, (no collector), 1 m (MAPA); Porto Alegre, 21.x.1961, A. Gentilli leg., 1 m (DZUP); Porto Alegre, 31.i.1965, (no collector), 1 f (MAPA); Porto Alegre, 29.x.1965, A. Gentilli leg., 1 f (DZUP); Porto Alegre, 08.xi.1967, A. Gentilli leg., 1 m (DZUP); Porto Alegre, 23.xi.1970, A. Baumann leg., 1 m (DZUP); Viamão, 03.xi.1971, A. Gentilli leg., 1 m (DZUP); Pelotas, 18.i.1977, Niemaber leg., 1 m (MECB); Morro Reuter, 12.ii.1983, 1 f (CLAM).

Citheronia vogleri (Weyenbergh, 1881) – Fig. 23.

Biezanko; Baucke (1948); Biezanko *et al.* (1949);

Silva *et al.* (1968)

Forewing length - f: 103–116mm [wingspan according to Lemaire (1988)]; m: 103–118mm [wingspan according to Lemaire (1988)].

Host families: Anacardiaceae, Loranthaceae, Myrtaceae.

Flight period: February, October and December.

Material examined. Pelotas, 29.x.1939, Irmãs Figueiredo leg., 1 f (MUCP); Pelotas, x.1945, (no collector), 1 f (DZUP); Pelotas, 22.xii.1945, Irmãs Figueiredo leg., 1 f (DZUP); Pelotas, 12.ii.1940, Irmãs Figueiredo leg., 1 f (MUCP).

***Procitheronia purpurea* (Oiticica, 1942) – Fig. 24.**

Nunes et al. (2003)

Citheronia (Procitheronia) principalis purpurea; Biezanko (1986)

Forewing length - f: 124–128mm [wingspan according to Lemaire (1988)]; m (1): 57.7mm.

Flight period: November.

Material examined. São Francisco de Paula, 20.xi.1998, A. Specht leg., 1 m (MCTP).

Othorene cadmus* (Herrich-Schäffer, [1854]) – Fig. 25.Adelocephala (Adelocephala) cadmus*; Biezanko (1986)

Forewing length - f: 130mm [wingspan according to Lemaire (1988)]; m: 95–112mm [wingspan according to Lemaire (1988)]. (see discussion below).

***Othorene purpurascens* (Schaus, 1905) – Fig. 26.**

Nunes et al. (2003)

Adelocephala (Oiticicia) purpurascens; Biezanko (1986)

Forewing length - f (1): 50.3mm; m (8): 38.3 ± 0.7mm.

Host families: Combretaceae, Myrtaceae, Sapotaceae.

Flight period: January, February, September and October.

Material examined. Canela, 13.i.1955, E. Corseuil leg., 1 m (MRGC); São Francisco de Paula, 07.i.1997, J. Teston leg., 1 m (MCTP); São Francisco de Paula, 10.i.1997, J. Teston leg., 1 m (MCTP); São Francisco de Paula, 12.ii.1999, J. Teston leg., 1 f (MCTP); Encruzilhada do Sul, 02–03.ii.2000, A. Moser leg., 1 m (CLAM); Barração, 21.ii.2000, R. A. Di Mare leg., 1 m (MCTP); Encruzilhada do Sul, 04–06.ix.2004, A. Moser leg., 2 m (CLAM); São Francisco de Paula, 12–14.x.2004, Moser, Nunes & Prestes leg., 1 m (CLAM); São Francisco de Paula, 20–22.x.2006, F. Quadros leg., 1 m (MCTP).

Cicia crocata* (Boisduval, 1872) – Fig. 27.Adelocephala (Oiticicia) crocata*; Biezanko (1986)

Forewing length - f: 40–53mm [wingspan according to Lemaire (1988)]; m: 34–42mm [wingspan according to Lemaire (1988)]. (see discussion below).

Host family: Fabaceae: Caesalpinoideae.

Cicia nettia* (Schaus, 1921) – Fig. 28.Adelocephala (Oiticicia) nettia*; Biezanko (1986)

Forewing length - f: 67mm [wingspan according to Lemaire (1988)]; m: 47–52mm [wingspan according to Lemaire (1988)].

Flight period: September and November.

Material examined. Guarani das Missões, 05.xi.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 20.ix.1933, C. Biezanko leg., 1 m (MECB).

***Almeidella approximans* (Schaus, 1921) – Fig. 29.**

Biezanko (1986); Nunes et al. (2003)

Forewing length - f: 68–82mm [wingspan according to Lemaire (1988)]; m (3): 33.2 ± 0.5mm.

Flight period: October.

Material examined. São Francisco de Paula, 08.x.1999, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 08.x.1999, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 08.x.1999, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 12–14.x.2004, Nunes, Prestes & Moser leg., 1 m (CLAM).

***Almeidella corrupta* (Schaus, 1913) – Fig. 30.**

Biezanko (1986)

Forewing length - f: 84–88mm [wingspan according to Lemaire (1988)]; m (1): 33.9mm.

Flight period: October.

Material examined. Morro Reuter, 08.x.1994, A. Moser leg., 1 m (CLAM); Morro Reuter, 10–14.x.2005, A. Moser leg., 1 f (CLAM); Morro Reuter, 5–6.x.2007, A. Moser leg., 1 f (CLAM).

****Mielkesia paranaensis* (Rego-Barros & Mielke, 1968) – Fig. 31.**

Forewing length - m (1): 26.4mm.

Flight period: September.

Material examined. Piratini, 11.ix.1999, A. Specht leg., 1 m (MCTP).

***Psilopygida crispula* (Dognin, 1905) – Fig. 32.**

Biezanko (1986)

Forewing length - f: 42–55mm [wingspan according to Lemaire (1988)]; m: 31–43mm [wingspan according to Lemaire (1988)]. (see discussion below).

Host family: Fabaceae: Caesalpinoideae, Fabaceae: Mimosoideae.

Psilopygida walkeri* (Grote, 1867) – Fig. 33.Adelocephala rosea*; Mabilde (1896); Mielke & Casagrande (1990)*Syssphinx apollinairei*; Draudt (1929–1930)*Adelocephala walkeri*; Travassos & May (1943)*Adelocephala (Oiticicia) walkeri rosea*; Biezanko (1986)

Forewing length - f (6): 31.4 ± 0.5mm; m (3): 25.6 ± 0.2mm.

Flight period: January to April, June, November and December.

Material examined. Pareci Novo, 30.vi.1932, (no collector), 1 m (MAPA); Pareci Novo, 24.xi.1932, (no collector), 1 f (MAPA); Pelotas, 15.xii.1938, I. Figueiredo leg., 1 f (MUCP); Pelotas, 02.ii.1941, I. Figueiredo leg., 1 f (MUCP); Pelotas, iv.1944, C. Biezanko leg., 1 m (MECB); Porto Alegre, 27.iii.1958, R. G. Costa leg., 1 m (FASE); Canoas, 28.ii.1959, E.R. Netto leg., 1 f (MRGC); Pelotas, 29.i.1960, C. Biezanko, 1 m (MECB); Porto Alegre, 19.iii.1960, (no collector), 1 f (MAPA); Pelotas, 21.iii.1963, C. Biezanko leg., 1 f (MECB); Porto Alegre, 16.i.1967, J. Mendicelli leg., 1 f (FASE); Pelotas, 16.iii.1969, C. Brack leg., C. Biezanko, 1 m (MECB); Porto Alegre, 17.iii.1971,

(no collector), 1 f (MAPA); Salvador do Sul, i.1995, A. Specht leg., 1 f (MCTP); Torres 13.iii.2000, A. Parise leg., 1 m (MCTP); Maquiné, 13–14.i.2005, A. Moser leg., 1 m (CLAM).

***Syssphinx molina* (Cramer, 1780) – Fig. 34.**

Ronna (1933); Costa Lima (1936); Biezanko *et al.*

(1949); Biezanko (1986); Lemaire (1988)

Syssiphinx molina; Mabilde (1896); Silva *et al.* (1968)

Forewing length - f (3): 49.8 ± 3 mm; m (14): 38.2 ± 0.6 mm.

Host families: Anacardiaceae, Ebenaceae, Fabaceae; Caesalpinoideae, Fabaceae: Faboideae, Fabaceae; Mimosoideae, Moraceae, Salicaceae.

Flight period: January to March, May, and September to November.

Material examined. Pelotas, 30.xi.1932, C. Biezanko leg., 1 m (MECB); Porto Alegre, 11.x.1934, (no collector), 1 m (MAPA); Pelotas, 19.ix.1939, I. Figueiredo leg., 1 m (MUCP); Taquari, ii.1941, R. Pain leg., 2 m (MRGC); Porto Alegre, 22.iii.1941, (no collector), 1 m (MAPA); Pelotas, 13.ii.1942, I. Figueiredo leg., 1 f (MUCP); Porto Alegre, 22.ii.1945, C. Machado leg., R.G. Costa, 1 m (MRGC); Porto Alegre, 13.v.1948, M. Jorge leg., J.M. Botelho, 1 f (MRGC); Pelotas, 25.x.1952, C. Biezanko leg., 1 m (MECB); Pelotas, 11.xi.1952, C. Biezanko leg., 1 m (MECB); Bento Gonçalves, ii.1954, J. Steiger leg., 1 f (MCNZ); Montenegro, 17.iii.1956, O. Baucke leg., 2 m (MRGC); Nova Petrópolis, 02.ii.1961, (no collector), 1 m (MCNZ); Nova Petrópolis, 17.ii.1964, (no collector), 1 f (MCNZ); Pelotas, 16.iii.1968, Illegible leg., 1 m (MECB); Santa Maria, 30.x.1971, J. Vasconcelos leg., 1 m (MECB); São Jerônimo, 24.ii.1982, T. Arigony leg., 1 m (MCNZ); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Derrubadas, 24.i.2001, R. A. Di Mare leg., 3 m (MCTP); Morro Reuter, 20.x.2001, A. Moser leg., 1 m (CLAM); Pelotas, 20.i.2005, A. Moser leg., 1 m (CLAM); Morro Reuter, 5–7.ii.2005, A. Moser leg., 1 m (CLAM); Maquiné, 6–7.iii.2005, A. Moser leg., 1 m (CLAM).

***Adeloneivaia subangulata subangulata* (Herrich-Schäffer, [1855]) – Fig. 35.**

Adelocephala subangulata; Weymer (1894); Mabilde (1896); Ronna (1933)

Syssphinx subangulata; Costa Lima (1936); Silva *et al.* (1968)

Forewing length - f: 67–84mm [wingspan according to Lemaire (1988)]; m (23): 28.2 ± 0.3 mm.

Host families: Moraceae, Salicaceae.

Flight period: January to March and September to December.

Material examined. Bento Gonçalves, ii.1954, J. Steiger leg., 1 m (MCNZ); São Sebastião do Caí, 17.iii.1956, O. Baucke leg., 1 m (MRGC); São Jerônimo, 24.ii.1982, (no collector), 1 m (MCNZ); São Jerônimo, 24.ii.1982, (no collector), 1 m (MCNZ); São Jerônimo, 22.x.1982, (no collector), 1 m (MCNZ); Morro Reuter, 30.x.1983, A. Moser leg., 1 m (CLAM); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Salvador do Sul, 12.x.1993, A. Specht leg., 1 m (MCTP); Pelotas, 22.ii.1994, Victor Becker leg., 1 m (MECB); Morro Reuter, 08.x.1994, A. Moser leg., 1 m (CLAM); Morro Reuter, 03.xi.1995, A. Moser leg., 1 m (CLAM); Morro Reuter, 24–28.xii.1996, A. Moser leg., 2 m (CLAM); Salvador do Sul, 01.i.1997, D. Becker leg., 1 m (MCTP); Iraí, 18.xii.1998, A. Specht leg., 1 m (MCTP); São Pedro da Serra, 19.ii.1999, A. Specht leg., 1 m (MCTP); Derrubadas, 14–18.i.2000, Moser & Araújo leg., 1 m (CLAM); Alegrete, 23.xi.2000, R. A. Di mare leg., 1 m (MCTP); Derrubadas, 24.i.2001, R. A. Di

Mare leg., 2 m (MCTP); Barracão, 21.ii.2001, R. A. Di Mare leg., 4 m (MCTP); Morro Reuter, 1–4.iii.2005, A. Moser leg., 1 f (CLAM).

***Adeloneivaia catharina* (Bouvier, 1927) – Fig. 36.**

Adeloneivaia apicalis; Biezanko (1986)

Forewing length - f: 68–77mm [wingspan according to Lemaire (1988)]; m (8): 27 ± 0.3 mm.

Flight period: January, April, May and October.

Material examined. Guarani das Missões, 17.x.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 19.x.1933, C. Biezanko leg., 1 m (MECB); Santa Maria, 25.x.1971, D. Link leg., 1 m (MECB); Santa Maria, 09.iv.1992, S. J. Bressan leg., 1 m (MECB); Morro Reuter, 18.i.1997, A. Moser leg., 1 m (CLAM); Derrubadas, 24.i.2001, R. A. Di Mare leg., 6 m (MCTP); Osório, 05.v.2001, A. Ferrari leg., 1 m (MCTP); Derrubadas, 14–18.i.2000, A. Moser leg., 1 m (CLAM).

***Adeloneivaia fallax* (Boisduval, 1872) – Fig. 37.**

Biezanko (1986); Lemaire (1988); Nunes *et al.* (2003)

Forewing length - f: 44.3mm; m (8): 33.6 ± 0.3 mm.

Host family: Fabaceae: Mimosoideae.

Flight period: January to March, July, September to November.

Material examined. Guarani das Missões, 16.x.1933, C. Biezanko leg., 1 m (MECB); Nova Petrópolis, 02.i.1961, (no collector), 1 f (MCNZ); Nova Petrópolis, 07.ii.1961, (no collector), 1 m (MCNZ); Morro Reuter, 28.vii.1982, A. Moser leg., 1 m (CLAM); Salvador do Sul, 07.ix.1995, A. Specht leg., 1 f (MCTP); Morro Reuter, 07–11.ii.1997, A. Moser leg., 1 m (CLAM); Camaquã, 19.x.1998, A. Specht leg., 1 m (MCTP); Barracão, 21.ii.2001, R. A. Di Mare leg., 1 m (MCTP); Morro Reuter, 17–20.ix.2004, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 24–25.x.2005, A. Moser leg., 1 m (CLAM); Morro Reuter, 1–4.iii.2005, A. Moser leg., 1 f (CLAM); Morro Reuter, 12–15.xi.2005, A. Moser leg., 1 m (CLAM).

***Adelowalkeria flavosignata* (Walker, 1865) – Fig. 38.**

Biezanko (1986); Lemaire (1988)

Forewing length - f (4): 51.4 ± 0.4 mm; m (7): 38.1 ± 0.7 mm.

Host family: Fabaceae: Faboideae.

Flight period: January, February, and September to December.

Material examined. Caxias do Sul, 20.ii.1931, (no collector), 1 m (MCNZ); Pareci Novo, 25.ix.1932, (no collector), 1 f (MAPA); Porto Alegre, 01.xi.1953, L. Buckup leg., 1 m (MCNZ); Nova Petrópolis, 27.i.1961, (no collector), 1 m (MCNZ); Santa Maria, 28.ix.1971, Link leg., 1 m (MECB); Santa Maria, 28.x.1971, Bergmann leg., 1 m (MECB); Lajeado, 28.i.1980, Nilde leg., 1 m (MECB); Morro Reuter, 30.x.1983, A. Moser leg., 1 m (CLAM); Erechim, 08.xi.1985, Mielke & Casagrande leg., 1 f (DZUP); Morro Reuter, 19.ii.1996, A. Moser leg., 1 m (CLAM); Morro Reuter, 13–16.i.2002, A. Moser leg., 1 f (CLAM); Morro Reuter, 31.xii.2003–02.i.2004, A. Moser leg., 2 m (CLAM); Morro Reuter, 10.i.2004, A. Moser leg., 2 f (CLAM).

***Adelowalkeria tristygma* (Boisduval, 1872) – Fig. 39.**

Biezanko (1986); Lemaire (1988); Nunes *et al.* (2003)

Forewing length - f: 90–96mm [wingspan according to Lemaire (1988)]; m (8): 31.8 ± 1 mm.

Flight period: January to March and July to November.

Material examined. Guarani das Missões, 03.iii.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 08.iii.1932, C. Biczanko leg., 1 m (MECB); Guarani das Missões, 14.iii.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 29.vii.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 18.x.1939, C. Biezanko leg., 1 f (MECB); Farroupilha, iii.1951, (no collector), 1 m (MECB); Guarani das Missões, 11.xi.1952, C. Biczanko leg., 1 m (MECB); Canela, 13.i.1955, E. Corseul leg., 1 m (MRCC); Santa Maria, 23.viii.1971, J. Vasconcelos leg., C. Biczanko, 1 m (MECB); Santa Maria, 25.x.1971, D. Link leg., 1 m (MECB); Santa Maria, 28.x.1971, L. I. Traesel leg., 1 f (MECB); Morro Reuter, 08.x.1994, A. Moser leg., 2 m (CLAM); Morro Reuter, 07–11.ii.1997, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 28.ii.1998, A. Specht leg., 1 m (MCTP); Barracão, 21.ii.2000, R. A. Di Mare leg., 2 m (MCTP); Encruzilhada do Sul, 04–06.ix.2004, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 12–15.x.2007, F. Quadros leg., 1 m (MCTP).

***Scolesa totoma* (Schaus, 1900) – Fig. 40.**

Nunes *et al.* (2003)

Forewing length - f (5): 30.5 ± 0.5 mm; m (18): 23.8 ± 0.4 mm.

Flight period: every month except April, July, and December.

Material examined. Pelotas, 14.viii.1939, C. Biezanko leg., 1 m (MECB); Nova Petrópolis, 05.ii.1961, (no collector), 1 f (MCNZ); Nova Petrópolis, 06.ii.1961, (no collector), 1 m (MCNZ); Nova Petrópolis, 01.xi.1961, (no collector), 1 f (MCNZ); Nova Petrópolis, 15.xi.1961, (no collector), 1 m (MCNZ); Morro Reuter, 08.i.1983, A. Moser leg., 1 m (CLAM); Morro Reuter, 15.v.1983, A. Moser leg., 1 m (CLAM); Morro Reuter, 30.x.1983, A. Moser leg., 1 m (CLAM); Morro Reuter, 09.ii.1991, A. Moser leg., 1 m (CLAM); Morro Reuter, 06.vi.1992, A. Moser leg., 1 m (CLAM); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Morro Reuter, 08.x.1994, A. Moser leg., 1 m (CLAM); Salvador do Sul 21.i.1995, A. Specht leg., 1 m (MCTP); Morro Reuter, 19.ii.1996, A. Moser leg., 1 f (CLAM); Morro Reuter, 19.ii.1996, A. Moser leg., 2 m (CLAM); Morro Reuter, 07.iii.1998, A. Moser leg., 1 f (CLAM); Morro Reuter, 27.iii.1998, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 11.ii.1999, A. Specht leg., 1 m (MCTP); São Francisco de Paula, 16.vi.1999, A. Specht leg., 1 m (MCTP); Barracão, 21.ii.2001, R. A. Di Mare leg., 1 f (MCTP); São José dos Ausentes, 02–04.ii.2002, A. Moser leg., 1 m (CLAM); Encruzilhada do Sul, 04–06.ix.2004, A. Moser leg., 1 m (CLAM); São Francisco de Paula, 12–15.x.2007, F. Quadros leg., 1 m (MCTP).



Figs. 27–45. Ceratocampinae of Rio Grande do Sul, Brazil (male dorsal view). **27.** *Cicia crocata*. **28.** *Cicia nettia* (cf. D'Abreu 1995). **29.** *Almeidella approximans*. **30.** *Almeidella corrupta*. **31.** *Mielkesia paranaensis*. **32.** *Psilopygida crispula* (cf. D'Abreu 1995). **33.** *Psilopygida walkeri*. **34.** *Syssphinx molina*. **35.** *Adeloneivaia subangulata subangulata*. **36.** *Adeloneivaia catharina*. **37.** *Adeloneivaia fallax*. **38.** *Adeloneivaia flavosignata*. **39.** *Adeloneivaia tristygma*. **40.** *Scolesa totoma*. **41.** *Scolesa viettei*. **42.** *Scolesa hypoxantha* (cf. D'Abreu 1995). **43.** *Citioica anthonilis*. **44.** *Oiticella luteciae*. **45.** *Neocarneugia basirei*.

***Scolesa viettei* Travassos, 1959 – Fig. 41.**

Lemaire (1988)

Forewing length - f (2): 40 ± 0.5 mm; m (16): 32.3 ± 1 mm.

Flight period: January to March, May, and August to October.

Material examined. Guarani das Missões, 13.iii.1932, C. Biezanko leg., 1 m (MECB). Guarani das Missões, 21.iii.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 19.ii.1933, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 05.v.1933, C. Biezanko leg., 1 m (MECB); São Sebastião do Caí, 16.x.1954, O. Baucke leg., 1 m (MRGC); Canela, 13.i.1955, O. Baucke leg., 1 m (MRGC); São Sebastião do Caí, 17.iii.1956, O. Baucke leg., 1 m (MRGC); Morro Reuter, 07.ix.1982, A. Moser leg., 1 m (CLAM); Morro Reuter, 12–16.x.1983, A. Moser leg., 1 m (CLAM); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Morro Reuter, 06.x.1995, A. Moser leg., 1 m (CLAM); Morro Reuter, 04.x.1996, A. Moser leg., 1 f (CLAM); Barracão 21.ii.2001, R. A. Di Mare leg., 6 m (MCTP); Barracão 21.ii.2001, R. A. Di Mare leg., 1 m (MCTP); Morro Reuter, 18.viii.2001, A. Moser leg., 1 m (CLAM); Morro Reuter, 17–20.ix.2004, A. Moser leg., 1 f (CLAM); Morro Reuter, 17–20.ix.2004, A. Moser leg., 1 m (CLAM); Morro Reuter, 1–4.iii.2005, Moser leg., 1 f (CLAM); Maquiné, 6–7.iii.2005, A. Moser leg., 2 m (CLAM); São Francisco de Paula, 12–14.x.2004, Nunes, Prestes & Moser leg., 1 m (CLAM); São Francisco de Paula, 20–22.x.2006, F. Quadros leg., 1 m (MCTP).

***Scolesa hypoxantha* (W. Rothschild, 1907) – Fig. 42.**Adelowalkeria (*Scolesa*) *hypoxantha*; Biezanko (1986)

Forewing length - m: 54mm [wingspan according to Lemaire (1988)].

Flight period: October.

Material examined. Santa Maria, 08.x.1971, D. Link leg., 1 m (MECB).

***Citioica anthonilis* (Herrich-Schäffer, [1854]) – Fig. 43.**Adelocephalia *anthonilis*; Mabilde (1986)Adelowalkeria (*Scolesa*) *anthonilis*; Biezanko (1986)

Forewing length - f: 75–106mm [wingspan according to Lemaire (1988)]; m (1): 29mm.

Flight period: January.

Host families: Fabaceae; Faboideae, Salicaceae.

Material examined. Derrubadas, 14–18.i.2000, A. Moser & Araújo leg., 1 m (CLAM).

***Oiticella luteiae* (Bouvier, 1924) – Fig. 44.**

Lemaire (1988)

Forewing length - f: 79mm [wingspan according to Lemaire (1988)]; m (7): 31.9 ± 1.6 mm.

Flight period: January to April, August, and October.

Material examined. Guarani das Missões, 09.iii.1932, C. Biezanko leg., 2 m (MECB); Guarani das Missões, 04.iv.1932, C. Biezanko leg., 1 m (MECB); Guarani das Missões, 05.v.1933, C. Biezanko leg., 1 m (MECB); Porto Alegre, viii.1940, R.G. Costa leg., 1 m (MRGC); Canela, 13.i.1955, O. Baucke leg., 1 m (MRGC); Morro Reuter, 30.x.1983, A. Moser leg., 1 m (CLAM); Pelotas, 13.i.1984, Abud leg., 1 m (MECB); Morro Reuter, 24.x.1992, A. Moser leg., 1 m (CLAM); Morro Reuter, 04.x.1996, A. Moser leg., 1 m (CLAM); Morro Reuter, 07–11.ii.1997, A. Moser leg., 1 m (CLAM); Derrubadas, 24.i.2001, R.

A. Di Mare leg., 1 m (MCTP); Morro Reuter, 1–4.iii.2005, A. Moser leg., 1 m (CLAM).

***Neocarnegia basirei* (Schaus, 1892) – Fig. 45.**

Biezanko & Baucke (1948); Biezanko (1986); Lemaire (1988)

Forewing length - f (7): 43.5 ± 0.7 mm; m: 54–73mm [wingspan according to Lemaire (1988)].

Host families: Fabaceae; Caesalpinoideae, Fabaceae; Faboideae.

Flight period: January, October and December.

Material examined. Pareci Novo, 20.x.1932, (no collector), 1 f (MAPA); Pareci Novo, 20.x.1933, (no collector), 1 f (MAPA); Pareci Novo, 21.x.1933, (no collector), 1 f (MAPA); São Leopoldo, i.1962, (no collector), 2 f (MAPA); Morro Reuter, 12.xii.1982, A. Moser leg., 1 f (CLAM); Salvador do Sul, 17.xii.1998, A. Specht leg., 1 f (MCTP); Morro Reuter, 10–14.x.2005, A. Moser leg., 1 m (CLAM).

DISCUSSION

There are some species not included in the list because (A) - they were not found at the examined collections, (B) - their respective geographical distributions are discrepant following Lemaire (1980, 1988, 1996), and (C) – they were previously misidentified. The inclusion of these species must be verified with vouchers from the State:

Arsenurinae

- *Paradaemonia phluto* (Westwood). Reported for Rio Grande do Sul by Silva *et al.* (1968), (as *Dysdaemonia phluto*) Ronna (1934), and Costa Lima (1936): A and B. Voucher distribution: Rio de Janeiro.

- *Copiopteryx semiramis phoenix* (Deyrolle). Reported for Rio Grande do Sul by Costa Lima (1936), and Biezanko & Baucke (1948), (as *Endemonia semiramis phoenix*) Mabilde (1896) and Silva *et al.* (1968): A and B. Voucher distribution: Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo.

- *Rhescoyntis hippodamia hippodamia* (Cramer). Reported for Rio Grande do Sul (as *Machaeroptera martii*) by Silva *et al.* (1968): A and B. Voucher distribution: Bolivia, Brazil (Amapá, Pará, Distrito Federal and Goiás), Colombia, Ecuador, Guyana, French Guyana, Peru, Surinam and Venezuela.

- *Arsenura aspasia* (Herrich-Schäffer). Reported for Rio Grande do Sul by Biezanko & Seta (1939), and Biezanko & Baucke (1948), (as *Rhescoyntis aspasia*) Mabilde (1896), Silva *et al.* (1968) and Biezanko (1986): B and C. Voucher distribution: Rio de Janeiro. We identified the specimens found at the Biezanko (MECB) and Mabilde (MCNZ) collections as *Arsenura biundulata*.

- *Dysdaemonia boreas* (Cramer). Reported for Rio Grande do Sul (as *Rhescoyntis boreas*) by Biezanko

(1986): B and C. Vouchered distribution: Central America, Andes (low altitudes), and Guyana-amazonian region, Brazil (Pará and Mato Grosso). We identified the specimen found at the Biezanko collection (MECB) as *Dysdaemonia brasiliensis*.

- *Dysdaemonia fosteri* W. Rothschild. Reported for Rio Grande do Sul (as *Rhescyntis fosteri*) by Biezanko (1986): A and B. Vouchered distribution: Bolivia, Paraguay and Argentina (Jujuy, Tucuman).

- *Arsenura pandora* (Klug). Reported for Rio Grande do Sul by Costa Lima (1936), (as *Rhescyntis pandora*) Mabilde (1896), Ronna (1933), Biezanko (1986) and Silva *et al.* (1968): B and C. Vouchered distribution: Goiás and Minas Gerais (endemic to Brazilian plateaus). We identified the specimens found at the Biezanko collection (MECB) as *Arsenura orbignyanus*.

Ceratocampinae

- *Adeloneivaia irrorata* (Schaus). Reported for Rio Grande do Sul by Biezanko (1986): A and B. Vouchered distribution: Mexico, Belize and Guatemala.

- *Scolesa leucantha* (Boisduval). Reported for Rio Grande do Sul by D'Abreia (1995), and (as *Adelowalkeria (Scolesa) argyraea* (Boisduval)) by Biezanko (1986): B and C. Vouchered distribution: endemic to southeastern Brazil - Rio de Janeiro and São Paulo. We identified the specimens found at the Biezanko collection (MECB) as *Scolesa viettei* after genitalic observation.

- *Oiticella brevis* (Walker). Reported for Rio Grande do Sul (as *Adelowalkeria brevis* and as *Adelowalkeria (Scolesa) lanaris* (Rothschild)) by Biezanko (1986): B and C. Vouchered distribution: northeast, central-west and southeast of Brazil. We identified the specimens found at the Biezanko collection (MECB) as *Oiticella luteiae* after genitalic observation.

- *Citheronia brissotti meridionalis* (Bouvier). Reported for Rio Grande do Sul by Biezanko & Baucke (1948), Silva *et al.* (1968) and Biezanko (1986): B and C. Vouchered distribution: Argentina. We identified the specimens found at the Biezanko collection (MECB) as *Citheronia brissotti brissotti*.

- *Citheronia splendens splendens* (Druce). Reported for Rio Grande do Sul (as *Eacles splendens splendens*) by Mabilde (1896), Ronna (1933), Costa Lima (1936) and Silva *et al.* (1968): A and B. Vouchered distribution: North America.

- *Eacles imperialis cacicus* (Boisduval). Reported for Rio Grande do Sul (as *Citheronia imperialis cacicus*) by Ronna (1933), Biezanko *et al.* (1957) and Biezanko (1986): B and C. Vouchered distribution: Guyana-amazonian region. We identified the specimens found at the Biezanko collection (MECB) as *Eacles imperialis*

magnifica. Lemaire (1988) defined *E. imperialis* as a complex of 11 subspecies distributed from southern Canada to northern Argentina. Phenotypically and according to its range our vouchers were identified as *E. i. magnifica*.

- *Eacles imperialis imperialis* (Drury). Reported for Rio Grande do Sul by Biezanko & Baucke (1948), Biezanko *et al.* (1949) and Silva *et al.* (1968): A and B. Vouchered distribution: United States.

- *Eacles penelope* (Cramer). Reported for Rio Grande do Sul by Mabilde (1896), Ronna (1933), Costa Lima (1936), Biezanko *et al.* (1949), Silva *et al.* (1968) and Biezanko (1986): B and C. Vouchered distribution: Central Ameriea and South America; in Brazil, Santa Catarina is the southern State in its distribution; it flies just in low altitude. We identified the specimens found at the Biezanko collection (MECB) as *Eacles ducalis*. These two species are similar in their wing facies, but the distinction is visualized on the sub-cirele discal spot, which is hyaline in *E. penelope*. The high frequency of citations may be related to that similarity.

We kept in the list three species of Ceratocampinae reported by Biezanko (1986), although we had not found specimens in the examined collections. These moths have their distribution recorded near to Rio Grande do Sul following Lemaire (1988, 1996) and we admit that they probably occur in the State. These species are:

- *Cicia crocata*, it occurs in the central-meridional region of Brazil.

- *Othorene cadmus*, its distribution is from Espírito Santo to Santa Catarina.

- *Psilopygida crispula*, it occurs in northeastern Argentina (Entre Ríos).

Well-sampled and undersampled areas. The survey of Rio Grande do Sul has been done sporadically over several years. There are 49 sampled localities in different environments in the State, however, four areas have the greatest effort—Porto Alegre (84), Morro Reuter (82), São Francisco de Paula (59), and Pelotas (59) are the best-known cities, comprising 53.4% of our data. Pelotas is located in the southern part of the State, near Patos lagoon in the Riograndense Shield; it includes fields, savannas and semi-deciduous tropical forest. Biezanko and Irmãs Figueiredo had done collecting in this region in the early 1940's to 1970's, but since then few expeditions have been done. Porto Alegre, the State's capital, has always had entomologists; nonetheless, due to extensive urbanization, few places remain as refuges for the speeies. The city is in the beginning of the mountain ridge of the sandstone-

basaltic plateau in a transitional area between the biomes, now characterized as an ecological tension zone. Morro Reuter is 50 km north from Porto Alegre; it is a rich plateau with conserved hillsides and an altitude lying between 400–600m. The vegetation includes semi-deciduous tropical forest and few araucaria trees; one of us (A. Moser) has collected Lepidoptera specimens there since 1980. Finally, São Francisco de Paula is 60 km northeast from Morro Reuter; it is among the highest places in the State where the elevation lies above 800m. Araucaria moist forest and hillsides with semi-deciduous and even Atlantic moist forest are present in this region. The PUCRS' Entomology laboratory has frequently done expeditions to this area since the early 1990's.

In addition, other regions are relatively well known. Biezanko (1986) reported on the Lepidoptera of the Missioneira region of Rio Grande do Sul, located in the west-northwest area on the sandstone-basaltic plateau with altitude lying between 200–400m. Nevertheless, we have only 19 records for Guarani das Missões city and 4 for Cerro Largo. It is unfortunate that many specimens from different regions might have been lost due to past lack of care at the entomological collections.

The west side of Rio Grande do Sul, especially the fields and savannas of the southwest, is very poorly documented. Moreover, the anthropogenic homogenization of the landscape as a result of agricultural practices has grown rapidly throughout the south, mainly by silviculture and cattle-raising. Thus, we suggest additional collecting especially in these undersampled areas.

Finally, despite the obvious shortcomings of our data, some comments can be made.

Abundant species and historical presence. Together, *Arsenura biundulata* (33) and *Paradaemonia thelia* (33) represent 44% of the Arsenurinae sampling effort. Similarly, *Eacles imperialis magnifica* (56), *Eacles ducalis* (37) and *Citheronia brissotii brissotii* (38) comprise 34,4% of the ceratocampine vouchers. Such species have been collected since the early part of the last century, indicating abundant populations and wide distribution over both biomes, except for *P. thelia*, which seems to occur mainly in low altitudes at the Pampa. This wide range may explain phenotypic variation in some of these species. *C. b. brissotii*, particularly, shows variation on its hindwing where the size of the basal mark can cover more than a half the wing or not. Also, *E. i. magnifica* and *E. ducalis* vary in the small spots along the wings, being more or less numerous.

There are some historically recorded species that have not been seen in a long time: *Citheronia johnsoni* (since 1954), *Citheronia laocon* (since 1983),

Citheronia vogleri (since 1945), *Cicia nettia* (since 1933), and *Scolesa hypoxantha* (since 1971).

Citheronia johnsoni was described in 1928 by Schaus, and its type locality is Santa Cruz do Sul, situated at the State's middle-west in the Central Depression. Lemaire (1988) wrote that it is probably endemic to southern Brazil. We examined two vouchers from Porto Alegre (140 km east from Santa Cruz do Sul) collected in 1939 and 1959. This species may actually be restricted in its distribution, yet additional collecting in its type locality and surrounding areas has to be done. Similarly, *C. laocon* was seen in Porto Alegre and nearby cities beyond, Pelotas, Cerro Largo, and Morro Reuter between 1948 and 1983; it has a wide distribution at the eastern Andes of almost all South America (Lemaire 1988). Gallo *et al.* (2002) consider this species to be a pest of *Coffea arabica* L., an important Brazilian product. Regardless, its population seems to be small in Rio Grande do Sul, or at least not often seen.

Citheronia vogleri was collected in Pelotas by Irmãs Figueiredo in the 1940's; following Lemaire (1988) it occurs in Bolivia, Paraguay, Argentina and Uruguay; he reported the difficulty in defining its distribution due to disjointed data. He added that it was found in abundance from Entre Ríos (Argentina), which indicates incompatibility with its presence in areas of semi-arid plateaus and even high mountains where it has been primarily reported. Entre Ríos and Pelotas are in the Pampa. However, we cannot suggest any conclusive argument about this and to consider this species rare or a stray for Rio Grande do Sul would require further evidence. The lack of such evidence also applies to *C. nettia* and *S. hypoxantha*, collected on the State's west side.

Ecological notes. Some species appear to inhabit mostly specific locations in Rio Grande do Sul. The arsenurine moths *Caio romulus*, *Paradaemonia meridionalis*, *Rhesocystis pseudomartii*, and *Titaea tamerlan tamerlan*, and *ceratocampine Eacles bertrandi*, and *Procitheronia purpurea* seem to live at high altitudes of the State's northeast and its hillsides regions (Maquiné) in the Atlantic Forest biome. They occur in São Francisco de Paula and adjacent areas where the elevation lies over 800m. One of us (A. Moser) has done collecting in Morro Reuter (550m) since 1980 and did not find these species; on the other hand, going 60 km to northeast and 250m up we find all of them. Rio Grande do Sul is their extreme meridional extent. The new records for the State, *R. pseudomartii*, *T. t. tamerlan*, *E. bertrandi* were collected in those conditions; *E. mayi* was also seen in Porto Alegre in 1960, and *Mielkesia paranaensis* was collected just in Piratini (350m). *Almeidella approximans* has specimens



Figs. 46–48. Distribution maps of Arsenurinae of Rio Grande do Sul, Brazil. 46. *Arsenura armida*, *Arsenura biundulata*, *Arsenura orbygniana*, and *Arsenura xanthopuss*. 47. *Caio romulus*, *Dysdaemonia brasiliensis*, *Titaea tamerlan tamerlan*, *Paradaemonia meridionalis*, and *Paradaemonia thelia*. 48. *Rhescyntis pseudomartii*, *Copiopteryx decrato*, and *Copiopteryx sonthonnaxi*.



Figs. 49–52. Distribution maps of Ceratocampinae of Rio Grande do Sul, Brazil. 49. *Eacles imperialis magnifica*, *E. ducalis*, *E. mayi*, and *E. bertrandi*. 50. *Citheronia brissotii brissotii*, *C. johnsoni*, *C. laocoon*, and *C. vogleri*. 51. *Procitheronia purpurea*, *Othorene purpurascens*, *Cicia nettia*, *Almeidella approximans*, *A. corrupta*, and *Mielkesia paranaensis*. 52. *Psilopygida walkeri* and *Syssphinx molina*.



Figs. 53–56. Distribution maps of Ceratocampinae of Rio Grande do Sul, Brazil. 53. *Adeloneivaia subangulata subangulata*, *A. catharina*, and *A. fallax*. 54. *Adelowlakeria flavosignata* and *A. tristygma*. 55. *Scolesa totoma*, *S. vitteti*, and *S. hypoxantha*. 56. *Citioica anthonilis*, *Oiticella luteiae*, and *Neocarnegia basirei*.

only from São Francisco de Paula in our data; however, this species was reported by Biezanko (1986) in the Missioneira region.

The majority of Rio Grande do Sul's species are endemic to east-southeastern Brazil, following Lemaire (1980, 1988, 1996). In the Arsenurinae, only 4 species do not inhabit exclusively this region: *Arsenura armida* (widely distributed from Mexico to Brazil), *A. orbignyana* (Bolivia and Brazil), *Paradaemonia meridionalis* (Brazil's central-meridional portion), and *P. thelia* (Paraguay and Brazil). In the Ceratocampinae, 16 species are endemic to the east-southeast of Brazil - *Eacles imperialis magnifica*, *E. ducalis*, *E. mayi*, *E. bertrandi*, *Citheronia brissotii brissotii*, *C. johnsoni*, *Procitheronia purpurea*, *Othorene cadmus*, *Cicia nettia*, *Almeidella approximans*, *A. corrupta*, *Mielkesia paranaensis*, *Adeloneivaia fallax*, *Scolesa totoma*, *S. vitteti*, and *Neocarnegia basirei*. This area includes the Atlantic forest biome and the Pampa biome at the southern extreme, where not all species were observed.

Also, *Cicia crocata* is endemic to Brazil, flying over the central-meridional region.

The greatest number of species in the State occurs in an area corresponding to the beginning of the mountain ridge and the hillside regions, located on the east and northeast of the sandstone-basaltic plateau in the Atlantic Forest biome (see figs. 46–56). The greater diversity and abundance may be due to the variation in vegetation (Fig. 1) and the hypsometric characteristic of the region. Similarly, the lower diversity and abundance elsewhere in the State could be due to the anthropogenic homogenization of the landscape. However, sampling effort has been much greater in this region as well, and we suggest that additional collecting in undersampled regions may change our current understanding of the lepidopteran diversity in Rio Grande do Sul.

Dichotomous keys. Figures 2 and 3 show some morphological aspects used in the keys.

Dichotomous Keys

Arsenurinae

1 Four concavous median bands on the forewing.....*Rhescyntis pseudomartii*

1' Forewing with another aspect.....2

2 Submarginal small black spots below CuA1 to the forewing's end
and on the hindwing's anal margin to CuA2.....*Titaea tamerlan tamerlan*

2' Wings without spots like above.....3

3 Forewing with hyaline sub-triangular discal spot; hindwing prolongation longer than wing.....4

3' Forewing with hyaline sub-circular discal spot or discal spot absent;
hindwing prolongation absent or less than wing.....5

4 Submarginal hyaline marks between M1-CuA1.....*Copiopteryx sonthonnaxi*

4' Submarginal hyaline marks absent.....*Copiopteryx decrato*

5 Intervenous sub-triangular ribbon-like marks on the submarginal region of the wings.....6

5' Intervenous sub-triangular ribbon-like marks absent.....7

6 Brown frontal coloration between scapes.....*Paradaemonia meridionalis*

6' White frontal coloration between scapes.....*Paradaemonia thelia*

7 Hyaline sub-circular discal spot on the wings;
concave line on the anal angle to hindwing prolongation.....*Dysdaemonia brasiliensis*

7' Simple discal spot or with white axis; concave line on the anal angle absent.....8

8 Simple discal spot.....9

8' Discal spot with white axis.....10

9 Clear intervenous marks on the submarginal region of the hindwing.....*Arsenura biundulata*

9' Clear intervenous marks on the submarginal region absent.....*Arsenura armida*

10 Two submarginal black spots between M1-M3.....11

10' Submarginal black spots between M1-M3 absent.....*Caio romulus*

11 Brown tarsomeres.....*Arsenura orbigniana*

11' Yellow tarsomeres.....*Arsenura xanthopus*

Ceratocampinae

1 Hyaline marks along the wings.....*Neocarnegia basirei*

1' Wings without such hyaline marks.....2

2 Subcircular discal spot with axis; small intervenous hyaline marks on forewing
submarginal region between M1 and CuA1.....*Procitheronia purpurea*

2' Discal spot, if present, with another aspect; hyaline intervenous marks absents.....3

3 Series of intervenous spots subovular on forewing limbal area.....4

3' Limbal area with another aspect.....7

4 Series of intervenous spots merged.....*Citheronia laoocoon*

4' Intervenous spots not merged.....5

5 Ground color black.....*Citheronia vogleri*

5' Ground color other than black.....6

6 Hindwing discal spot subcircular, touching basal mark or visible just on the ventral face.....*Citheronia brissotti brissotti*

6' Hindwing discal spot sub-circular, not touching basal mark, visible on both facies.....*Citheronia johnsoni*

7 Subcircular discal spot on hindwing.....8

7' Subcircular discal spot on the hindwing absent.....12

8 Forewing outer margin cut.....*Syssphinx molina*

8' Outer margin not cut.....9

Dichotomous Keys (continued)

Ceratocampinae (continued)

9 Discal spot on wings white; meso-thorax with pair of white subcircular marks.....*Eacles dinalis*
 9' Discal spot and mesothoracic marks, if present, with another color.....10
 10 Clear yellow limbal region on the hindwing*Eacles imperialis magnifica*
 10' Limbal region with another color.....11
 11 Forewing apex and tornus angulated.....*Eacles mayi*
 11' Forewing apex and tornus sub-rounded.....*Eacles bertrandi*
 12 Distal bands on wings formed by intravenous concave lines.....*Mielkesia paranaensis*
 12' Distal bands, if present, with another aspect.....13
 13 Strongly marked venation on the wings.....14
 13' Weakly marked venation on the wings.....16
 14 Ground color yellow.....*Adeloneivaia fallax*
 14' Ground color brown or gray.....15
 15 Hindwing ground color gray.....*Citioica anthonilis*
 15' Hindwing ground color brown, with a purple basal mark.....*Oiticella luteiae*
 16 Discal spot on forewing white or absent.....7
 16' Discal spot on forewing black.....26
 17 Two to four subcircular discal spots on forewing.....18
 17' Zero or one discal spots on forewing.....19
 18 Abdomen with brown inter-segmental rings; distal band absent on forewing.....*Adelowalkeria flavosignata*
 18' Abdomen without rings; distal band present on forewing.....*Adelowalkeria tristygma*
 19 Pink basal and limbal regions on forewing.....*Psilopygida walkeri*
 19' Basal and limbal regions on forewing with other colors.....20
 20 Distal band present on forewing.....21
 20' Distal band absent on forewing.....23
 21 Ground color brown.....*Almeidella corrupta*
 21' Ground color other than brown.....22
 22 Meso and meta-thoracic legs white; hindwing ground color purple.....*Almeidella approximans*
 22' Legs yellow; hindwing ground color yellow.....*Cicia nettia*
 23 Abdominal ground color black.....*Scolesa totoma*
 23' Abdominal ground color other black.....24
 24 Convex distal band directed to forewing basal area.....*Cicia crocata*
 24' Rectilinear or weakly concave distal band directed to forewing inner margin.....25
 25 Forewing outer margin convex.....*Othorene purpurascens*
 25' Forewing outer margin rectilinear.....*Othorene cadmns*
 26 Forewing tornus angulated.....27
 26' Forewing tornus sub-rounded.....28
 27 Hindwing purple.....*Adeloneivaia subangulata subangulata*
 27' Hindwing brownish-yellow.....*Adeloneivaia catharina*
 28 Thorax gray with yellow ring.....*Scolesa hypoxantha*
 28' Thorax with other aspect.....29
 29 Purple discal spot on the forewing ventral face; hindwing purple.....*Scolesa viettei*
 29' Forewing without purple spot on ventral face; hindwing with other color.....*Psilopygida crispula*

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LITERATURE CITED

BALCÁZAR-LARA, M. & K. L. WOLFE. 1997. Cladistics of the Ceratocampinae (Lepidoptera: Saturniidae). *Tropical Lepidoptera*, Gainesville 8 (Suppl. 2): 1–53.

BIEZANKO, C. M. 1986. Adelocephalidae, Saturniidae, Mimalionidae, Lasiocampidae, Eupterotidae e Lymantriidae da Região Missionária do Rio Grande do Sul. *Revista Centro de Ciências Rurais*, Santa Maria 16 (2), 89–112.

BIEZANKO, C. M. & O. BAUCKE. 1948. Nomes populares dos lepidópteros no Rio Grande do Sul. *Agros*, Pelotas 1(3): 164–177.

BIEZANKO, C. M., R. E. BERTHOLDI, & O. BAUCKE. 1949. Relação dos principais insetos prejudiciais observados nos arredores de Pelotas, nas plantas cultivadas e selvagens. *Agros*, Pelotas 2: 156–213.

BIEZANKO, C. M., A. RUFFINELLI, & C. C. CARBONELL. 1957. Lepidoptera del Uruguay. Lista anotada das espécies. *Revista Facultad Agronomía*, Montevideo 46: 1–152.

BIEZANKO, C. M. & F. D. SETA. 1939. Catálogo dos insetos encontrados em Rio Grande e seus arredores: 1 - Lepidópteros. A. Universal, Pelotas. 15pp.

CAMARGO, A. J. A., O. H. H. MIELKE, & M. M. CASAGRANDE. 2007. Nova espécie de *Paradaemonia* Bouvier (Lepidoptera, Saturniidae, Arsenurinae) do centro-sul do Brasil. *Revista Brasileira de Zoologia*, Curitiba 24(4): 1131–1138.

COSTA LIMA, A. M. 1936. Terceiro catálogo de insetos que vivem nas plantas do Brasil. Ministério da Agricultura, Rio de Janeiro. 464pp.

COSTA LIMA, A. M. 1950. Insetos do Brasil: Lepidópteros. Escola Nacional de Agronomia, Rio de Janeiro. 420pp.

CUNHA, S. B. & A. J. T. GUERRA. 1998. Geomorfologia do Brasil. Bertrand Brasil, Rio de Janeiro. 388pp.

D'ABRERA, B. 1995. Saturniidae Mundi: Saturniid moths of the World. Part I. Keltern: Automeris Press. 177pp.

DRAUDT, M. 1929–30. Familie: Saturnidae [sic]. Pp. 713–768 (1929); 769–827, pl. 101–137, 142 (1930). In Seitz (ed.), *Die Gross-Schmetterlinge der Erde*, 6 Die Amerikanischen Spinner und Schwärmer. A. Kernen, Stuttgart. 1452pp.

GALLO, D., O. NAKANO, S. S. NETO, R. P. L. CARVALHO, G. C. BAPTISTA, E. B. FILHO, J. R. P. PARRA, R. A. ZUCCHI, S. B. ALVES, J. D. VENDRAMIM, L. C. MARCHINI, J. R. S. LOPES, & C. OMOTA. 2002. Entomologia Agrícola. ESALQ, Piracicaba. 920pp.

IBGE. 1986. Levantamento dos recursos naturais Folha SH.22 Porto Alegre e parte das folhas SH.21 Uruguaiana e SH.22 Lagoa Mirim: geologia, geomorfologia, pedologia, vegetação, uso potencial da terra. Projeto Radambrasil, Rio de Janeiro. 796pp.

LEMAIRE, C. 1980. Les Attaeidae Americains: Arsenurinae. Neuilly-sur-Seine: C. Lemaire. 199pp. + 76 illustrations.

LEMAIRE, C. 1988. Les Attaeidae Américains: Ceratocampinae. Museo Nacional de Costa Rica, San José. 616pp.

LEMAIRE, C. 1996. Bombycoidea, Saturniidae. Pp. 28–49. In Heppner, J. B. (ed.), *Atlas of neotropical Lepidoptera, checklist. Part 4B. Drepanoidea, Bombycoidea, Sphingidae*. Association for Tropical Lepidoptera, Gainesville. 87pp.

MABILDE, A. P. 1896. Guia práctico para os principiantes colecionadores de insectos, contendo a descrição fiel de perto de 1000 borboletas com 180 figuras litógrafadas em tamanho, forma e desenhos conforme o natural. Estudo sobre a vida de insetos do Rio Grande do Sul e sobre a caça, classificação e conservação de uma coleção mais ou menos regular. Gundlach & Schultdt, Porto Alegre. 238pp.

MARICONI, F. A. M. & L. G. E. LORDELLO. 1953. Uma praga florestal *Arsenura xanthopus* (Walker, 1855). *O Biológico*, São Paulo 10: 175–181.

MICHENER, C. D. 1952. The Saturniidae (Lepidoptera) of the Western Hemisphere: morphology, phylogeny, and classification. *Bulletin of the American Museum of Natural History*, New York 98: 335–502.

MIELKE, O. H. H. & M. M. CASAGRANDE. 1990. Sobre os tipos de lepidoptera depositados em museus brasileiros. XXI Papilionidae, Hesperiidae e Pieridae descritos por F. Hoffmann; Nymphalidae (Brassolinae) por L. Travassos & E. May; Lycaenidae por Draudt (suplemento); Papilionidae por Niepelt; Noctuidae por C. M. Biezanko e Saturniidae e Apatelodidae por A. Mabilde. *Revista Brasileira de Entomologia*, São Paulo 34(4): 713–719.

NUNES, F. G., A. SPECHT, & E. CORSEUIL. 2003. Saturnídeos (Lepidoptera, Saturniidae) ocorrentes no centro de pesquisas e conservação da natureza Pró-Mata. *Divulgações do Museu de Ciências e Tecnologia – UBEA/PUCRS*, Porto Alegre 8: 55–62.

PASTRAN, A. J. 2004. Los Lepidópteros Argentinos: sus plantas hospedadoras y otros sustratos alimenticios. *Sociedad Entomológica Argentina*, Buenos Aires. 334pp.

RONNA, E. 1923. Apontamentos de microfauna rio-grandense. 1 série. Lepidópteros. *Egatéa*, Porto Alegre 8(4): 253–257.

RONNA, E. 1933. Catálogo dos insetos até hoje encontrados nas plantas do Rio Grande do Sul. *Egatéa*, Porto Alegre 18(1–2): 47–53, (3): 96–100, (4): 197–202, (5): 275–578, (6): 329–334.

SILVA, A. G. D'A., C. R. GONÇALVES, D. M. GALVÃO, A. J. L. GONÇALVES, J. GOMES, M. N. SILVA, & L. SIMONI. 1968. Quarto catálogo dos insetos que vivem nas plantas do Brasil: Seus parasitos e predadores. Ministério da Agricultura, Rio de Janeiro. 622pp.

STONE, S. E. 1991. Foodplants of world Saturniidae. *Memoir of the Lepidopterists' Society* 4: 1–181.

TRAVASSOS, L. & E. MAY. 1943. Adelocephalinae da coleção Julius Arp. *Boletim do Museu Nacional* (nov. sér.), Rio de Janeiro 11: 1–22.

VIEIRA, E. F. 1984. Rio Grande do Sul: geografia física e vegetação. Sagra, Porto Alegre. 18 pp.

WEYMER, G. 1894. Exotische Lepidopteren VII. Beitrag zur Lepidopterenfauna von Rio Grande do Sul. *Entomologische Zeitung*, Stettin 10–12: 312–333.

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SYNONOMIZATION OF THE EUPHONIOUS ARCTONOTUS BOISDUVAL, 1852 (SPHINGIDAE:
MACROGLOSSINAE) BASED ON MOLECULAR PHYLOGENETIC ANALYSIS

Additional key words: Bear Sphinx, cytochrome oxidase I, elongation factor-1 α , *lucidus*, paraphyly, *Proserpinus*, wingless

Arctonotus Boisduval, 1852 is a monotypic hawkmoth genus proposed for the type species, *A. lucidus* Boisduval, 1852. In their monumental revision, Rothschild & Jordan (1903) inexplicably transferred *Proserpinus terlooii* Henry Edwards, 1875 to *Arctonotus*. This error was repeated by a few other workers (e.g., Holland 1903; d'Abraera 1987; Comstock 1948), but Hodges (1971) and Tuttle (2007) correctly recognized the many morphological similarities tying *P. terlooii* to the rest of *Proserpinus* Hübner, [1819]. Less clear were those features tying *A. lucidus* to *Proserpinus*, and the validity of *Arctonotus* as a genus distinct from *Proserpinus* has never been challenged, though several authors recognized the possibility of a sister taxon relationship (Hodges 1971; Kitching & Cadiou 2000; Tuttle 2007). Pronounced, ciliate male antennae and unusually heavy adult vestiture drove the recognition of *Arctonotus* (Boisduval, 1852). Additional unusual traits including a winter flight period, a reduced, vestigial proboscis, loss of the pulvillus, and inferred physiological adaptations required to fly in very cold temperatures (Edwards 1875; Holland 1903; Rubinoff 2002) are unique to *Arctonotus* and equivocally support its separation from *Proserpinus*.

However, we have suspected that *Arctonotus* might not be the sister taxon to *Proserpinus* but rather that *A. lucidus*' traits were derived by intense selective pressures associated with the winter flight period. This position is supported by many morphological and ecological similarities between the two genera. *Arctonotus lucidus* shares the green adult coloration, pattern of forewing banding, hindwing maculation and color all nearly identical to *P. terlooii* and *P. vega* (Dyar, 1903). Larvae of *A. lucidus* and all but one *Proserpinus* (*P. terlooii*) feed exclusively on Onagraceae. Further, the genera share virtually identical larval morphology and development patterns, including a dramatic change in the final instars (Osborne 1995, 2000; Rubinoff 2002; Tuttle 2007). In particular, color and maculation of fifth instar *A. lucidus* and *P. terlooii* are very similar (Osborne pers. obs.) whereas these traits are widely divergent and varied across other *Proserpinus* (Osborne 1995, 2000; Tuttle 2007). These morphological characters, though highly suggestive, have never lead to more than a proposed sister-taxon relationship between *Arctonotus* and *Proserpinus* (Hodges 1971; Kitching & Cadiou 2000; Tuttle 2007).

Recent molecular phylogenetic analysis (Fig 1.) has demonstrated that not only is *Arctonotus lucidus* a member of *Proserpinus*, but also that *A. lucidus* is deeply nested among the other species of *Proserpinus*, rendering *Proserpinus* paraphyletic and therefore systematically uninformative (Rubinoff & Le Roux 2008). Rubinoff and Le Roux's initial findings were subsequently corroborated with a different set of genes (Kawahara *et al.* 2009). Thus, the dramatic differences in the ecology and physiology of *Arctonotus lucidus* belie a phylogenetic relationship that places the genus squarely within *Proserpinus*. This is remarkable because it suggests the possibility of saltational evolution in those particular characters that have changed so dramatically in *Arctonotus* (Rubinoff & Le Roux 2008), while genes of *A. lucidus* have remained very typical of *Proserpinus*. A discussion of the evolutionary implications and phylogenetics of *Proserpinus* and *Arctonotus* is detailed in Rubinoff & Le Roux (2008). Because *Proserpinus* has priority, the nomenclatural change placing *Arctonotus* as a junior synonym and thereby maintaining the monophyly of *Proserpinus* is proposed here.

Proserpinus lucidus (Boisduval)

= [Combination Revised]: *Arctonotus lucidus*
Boisduval, 1852: 319. **comb. rev.**

We propose to maintain the common name Bear Sphinx for *P. lucidus*, in use for over a century (Holland 1903). The Greek root of *Arctonotus* refers to the stout, hairy ursine quality of the adult moth, and while the generic placement has changed, this reference remains accurate. Occasionally websites and authors have used 'Pacific Green Sphinx' for *P. lucidus*, but this more recent common name has no connection to the original description. It is further disadvantaged and confused due to the presence of *P. clarkiae*, another green *Proserpinus* widespread across the Pacific Region of North America.

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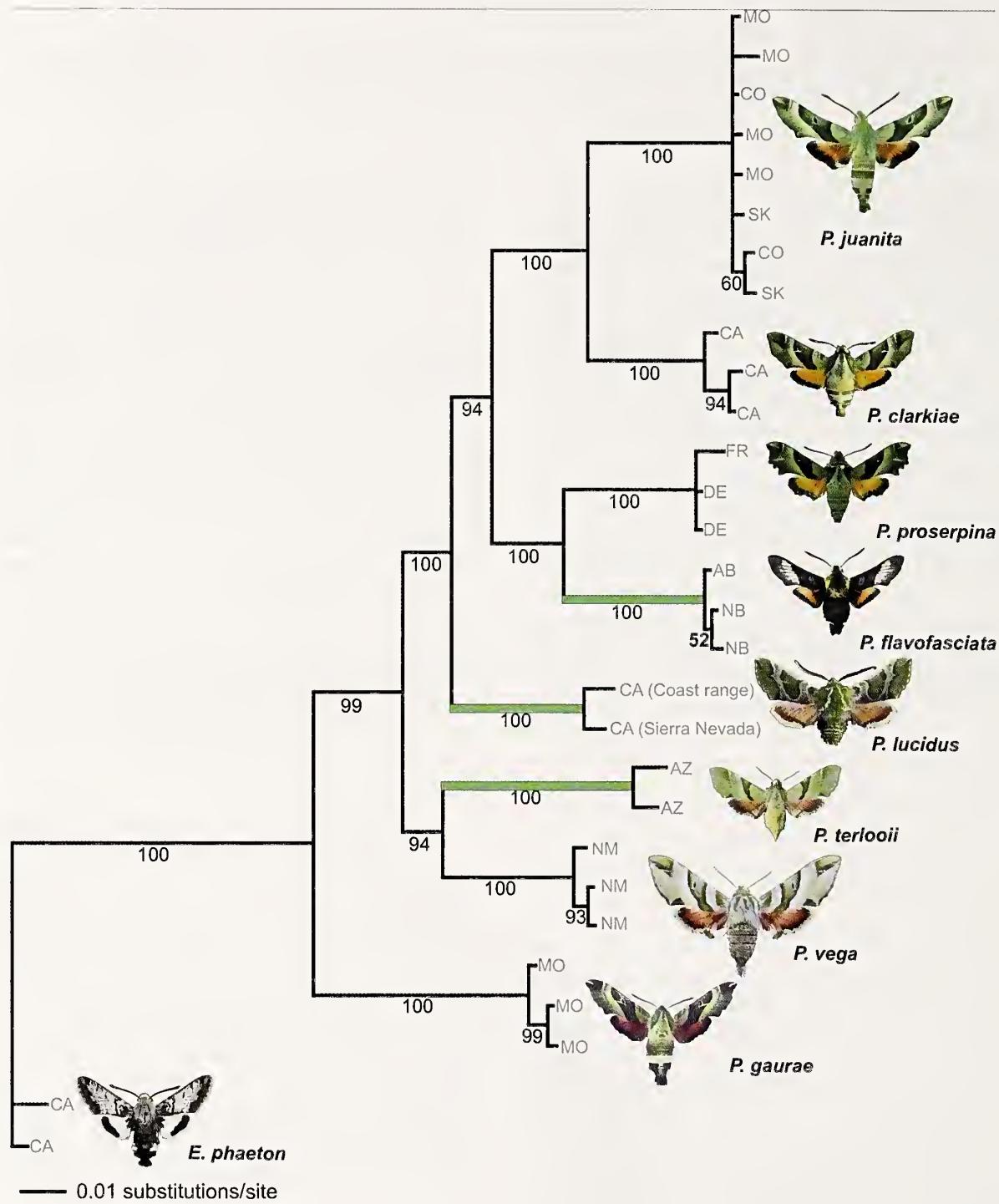


FIG. 1. Phylogeny of *Proserpinus*. *Euproserpinus phaeton* Grote & Robinson used as an outgroup. Modified from Rubinoff & Le Roux (2008), Bayesian consensus tree generated with posterior probabilities inferred from 1,965 base pairs of combined COI, EF-1 α , and wingless DNA sequence data. Branch support is given as posterior probabilities (numbers beneath branches). Length of branches corresponds to number of substitutions per site. Accession location data are mapped onto the tree (AB, Alberta [Canada]; AZ, Arizona; CA, California; CO, Colorado; DE, Germany; FR, France; MO, Missouri; NB, New Brunswick [Canada]; NM, New Mexico; SK, Saskatchewan [Canada]). Saltational taxa are highlighted in green.

LITERATURE CITED

BOISDUVAL, J. A. 1852. Lépidoptères de la Californie. Ann. Soc. Ent. France, 2nd ser., 10:275-324.

COMSTOCK, J. A. 1948. The mature larva and pupa of *Arctonotus terlootii* Hy. Edv. Bull. S. Calif. Acad. Sci. 47: 49-51.

D'ABRERA, B. 1987. Sphingidae Mundi: Hawk Moths of the World. London: E. W. Classey.

DYAR, H. G. 1903. New North American Lepidoptera with notes on larvae. Proc. Ent. Soc. Wash. 5: 290-298.

EDWARDS, H. 1875. Pacific coast Lepidoptera, no. 11- list of the Sphingidae of California and adjacent districts, with descriptions of new species. Proc. Calif. Acad. Sci. 6: 86-94.

HODGES, R.W. 1971. Sphingidae. Fascicle 21 of The Moths of North America North of Mexico, ed. R. B. Dominick *et al.* London: E. W. Classey.

HOLLAND, W. J. 1903. The Moth Book. New York: Doubleday and Page.

KAWAHARA, A. Y., MIGNAULT, A. A., REGIER, J. C., KITCHING, I. J., & C. MITTER. 2009. Phylogeny and biogeography of hawkmoths (Lepidoptera: Sphingidae): evidence from five nuclear genes. PLoS ONE: 4(3): e5719. doi:10.1371/journal.pone.0005719.

KITCHING, I. J. & J. CADOU. 2000. Hawkmoths of the World. Ithaca, Cornell University Press.

OSBORNE, K. H. 1995. Biology of *Proserpinus clarkiae* (Sphingidae). J. Lepid. Soc. 49: 72-79.

_____. 2000. Additional notes on *Proserpinus clarkiae* and *Arctonotus lucidus* (Sphingidae) life histories from the Pacific Coast of North America. J. Lepid. Soc. 53:170-172.

ROTHSCHILD, L. W. & K. JORDAN. 1903. A revision of the lepidopterous family Sphingidae. Novitates Zoologicae 9: 1-972.

RUBINOFF, D. 2002. Observations of adult and larval behavior in the winter sphingid, *Arctonotus lucidus* (Sphingidae). J. Lepid. Soc. 55: 78-79.

RUBINOFF, D. & J. J. LE ROUX. 2008. Evidence of repeated and independent saltational evolution in a peculiar genus of sphinx moths (*Proserpinus*: Sphingidae). PLoS ONE 3 (12): e4035. doi:10.1371/journal.pone.0004035.

TUTTLE, J. P. 2007. The Hawk Moths of North America. Lawrence Kansas: Allen Press.

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